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Proposals for a new battle-ship and a cruiser are asked by the U. S. Navy Department; the two ships to cost about $8,000,000. The cruiser is to be 400 ft. long, 64 ft. beam, 23 ft. draft, with 16,000 HP., capable of developing a speed of 20 knots. She is to carry 1,700 tons of coal, and will be armed with eight 8-in. and twelve 5-in. breech-loading rifles, and a strong auxiliary battery of Gatling and lb. guns. She will have a steaming endurance of 15,000 miles at a 10-knot rate, or 2,000 miles more than the "New York." The battle-ship will be 360 ft. long, 48 ft. beam, 24 ft. draft, with 11,000 HP., and a calculated speed of 16½ knots. Her armament will be four 12-in., and six 4-in. breech-loading rifles, and twenty 6-pdrs. and five 1-pd. rapid-fire guns.

Estimates for cleaning the streets of New York and removing ashes and garbage during 1893 place the total cost at $2,569,253. The total appropriations for this purpose thus far in 1892 have been $2,003,355, about $188,000 having been granted since the annual appropriation was made. The estimates for 1893 are distributed as follows:

Administration; office force of 24, and supervisory force of 146, $193,970; sweeping, 1,575 sweepers, 150 machine and water cart drivers, all at $600 per year, and sundries, $1,085,000; carting, 675 drivers at $690.92, hostlers at $720, shoeing and feeding 950 horses at $182.50, and sundries, $671,815; removal of snow and ice, $40,000; final disposition by means of tugs and scows, $322,800; new stock, as horses, carts, harness, etc., $197,338; rentals and contingencies, $58,330. The salary list varies from $6,000 for the Commissioner of Street Cleaning to $600 for sweepers.

The city is now divided into 11 districts, each under the charge of a superintendent. There are 58 street cleaning districts, each under the charge of a foreman. The superintendents and foremen are each responsible for the cleanly condition of the districts under their charge, and the sweepers are also held responsible for the length of street which it is their duty to sweep.

During the first eight months of 1892 there have been removed a total of 1,260,221 loads of dirt, against 1,135,045 during the same period of 1891, an increase of 125,176 loads, or about 11%.

The new street cleaning law provided for 1,500 sweepers, 750 drivers, and 88 hostlers on the start, with an addition to the force of 5% per year. The Commissioner, Mr. T. S. Brennan, reports that the system is efficient, but that while the Advisory Committee which formulated the new law thought the above force would be large enough at the start to clean the whole city, it has been found that at least twice the number of sweepers are required to clean all the paved streets and avenues, allowing one sweeper to each 600 or 800 ft. of streets, according to width. The down town streets are principally cleaned by hand, and the upper part of the city by machines, operated at night.

The long tunnel under the summit of the Cascade Mountains in Washington, on the Pacific extention of the Great Northern Ry., is now being surveyed. It will be 13,000 ft. long, and the second longest tunnel in this country. The tunnel will be on a tangent with a curve at the eastern approach. As it will take about three years to complete the tunnel, a switchback is being constructed to carry the trains across the summit for the present. The maximum grade of the switchback will be 3½% on the eastern side, and 4% on the western side of this mountain.

A folding bridge with a clear span of 80 ft. is being constructed over the Chicago River, at Canal St. The design of the bridge is the same as that over the river at Weed St., which was fully illustrated and described in our issue of May 23, 1891, and is the innovation of Mr. Wm. Harman, of the Chicago Towing Co. The contractors are Shailer & Schniglau, of Chicago, Ill.

The Harlem River drawbridge of the New York Central R. R. was opened 11,018 times during the year ending Sept. 1, 1891. This is 30 times a day for every day in the year. The Third Avenue draw, lower down on the river, was opened 16,285 times during the same period, or nearly 45 times per day.

The city of Providence has passed resolutions instructing the Commissioner of Public Works to carry out the plan of sewerage and sewage disposal designed by Mr. Samuel M. Gray, M. Am. Soc. C. E., of that city. This plan contemplates the construction of marginal sewers, pumping works, and precipitation works, it being the design to first treat the sewage chemically and discharge the clarified effluent into the Providence River, about two miles below the city. The works are estimated to cost upward of $2,000,000.

The most serious railway accident of the week was a rear collision Sept. 27, near Opelika, Ala., on the Western Ry. of Alabama. Near a small trestle a fast freight passenger engine struck two runaway freight cars, and the engine, tender, baggage car, mail car and one passenger car, together with the two freight cars, were thrown down the bank. The other passenger car and a Pullman car remained on the track. Two men were killed and six injured. The freight cars had got loose on a sidetrack, and run through a switch onto a long down grade on the main track. The wreck caught fire and was completely destroyed.

A bridge carrying the Lake Shore & Michigan Southern Ry. over the feeder canal at Fort Wayne, Ind., gave way under a freight train Sept. 27. We are indebted to Mr. E. A. Handy, Chief Engineer, for particulars of the bridge, which was six years old. It had one span of 40 ft., and consisted of wooden stringers undertrussed by two iron rods on each side. The cause of the failure was a defective weld in one truss rod, not likely to have been discovered by any inspection. Three freight cars were damaged, but the engine was not injured.

Two fatal collisions at grade crossings of street railway and steam railway tracks, again call attention to the dangers of these crossings. At Orange, N. J., a street car was struck by an express train on the Delaware, Lackawanna & Western R. R., Oct. 4, the gateman having failed to warn the car or close the gates. The car driver was killed and two persons were injured. On Oct. 4 a crowded street car at Cincinnati, O., was struck by a switch engine. Two persons were killed and four injured. The gateman thought the car would get across the track in time, and did not lower the gate until it had passed. It has been shown over and over again that gates and gatemen are not sufficient protection, and such crossings should be fitted with an automatic signal worked by approaching trains, or even a derailing switch worked in the same way. Such a switch could connect with a curve leading to a track parallel with the railway, and as the speed would be slow, this switch could be placed very near the crossing.

Two locomotive boiler explosions are among the accidents of the week. On Sept. 27, the boiler of a locomotive on the Tennessee Coal & Iron Co.'s line exploaded near Coalburg, Ala., and one man was killed. On Sept. 30, the boiler of a pusher engine on the Buffalo, Rochester & Pittsburg R. R. exploded near Grove Summit, Pa., and two men were killed. The engine was standing on the track, having just completed a run.

Four mills of the Schagticoke Powder Co., at Schagticoke, N. Y., blew up on Sept. 30, causing a loss of over $10,000. The first explosion was caused by the clogging up of the powder in the wheel mill. Some of the flying pieces struck the press mill, causing the second explosion, and the concussion from this set off the powder in the corning mill and the supply mill, 50 ft. distant. Buildings in Schagticoke village, two miles away, and in Valley Falls, a mile distant, were shaken, and scarcely a window remained whole. The explosion took place at 6 p. m., after the day forces quit work, and no one was injured.

The great litigation over incandescent lamp patents was ended on Oct. 4 by a decision of the United States Circuit Court of Appeals, the court of last resort, sustaining the Edison patent No. 223,898, dated Jan. 27, 1880. The opinion, prepared by Judges Lacombe and Shipman, lays stress on the practical results achieved by the invention, and holds that substituting a carbon filament for the platinum wire described in Edison's French patent of 1879 was a patentable improvement. The opinion says: "Edison's invention was practically made when he ascertained the heretofore unknown fact that carbon would stand high temperatures without disintegration, even when very attenuated, if operated in a high vacuum." This decision is the last of three important ones, all of which have sustained the Edison patent. The first was delivered by Justice Bradley, of the United States Supreme Court at McKeesport, Pa., in 1889. The second was handed down by Judge Wallace, of the United States Circuit Court, a few months ago. The Edison Co. will be entitled to a heavy accounting from manufacturers of incandescent lamps for past profits, but the patent has a little over four years more to run, so the public will not have to pay increased prices for lamps very long if the prices are raised.

Another important electrical patent case decided on the same day by the same court was that of the Brush Electric Co. vs. The Electric Accumulator Co., in which the plaintiff's patent, No. 337,290, was sustained. The defendants in the case owned the Faure patent, dated Jan. 3, 1882. These two patents were the subject of an interference case in the Patent Office, but the Brush patent was finally granted. The patent thus sustained is a fundamental one. Another patent of the Brush Co., No. 266,080, involved in the same suit, was held by the court to be not infringed.

The Siemens & Halske Co., of Chicago, an American branch of the famous Berlin firm, has taken a contract for what is claimed to be the largest isolated electric plant in existence, that for the Auditorium building in Chicago, and its new annex across the street, Congress Hall. The original Auditorium plant was of Edison manufacture, and this will be removed and the Siemens & Halske plant substituted. The power station will be of sufficient capacity to furnish current for 25,000 incandescent and 200 arc lamps, besides operating the passenger and freight elevators in both buildings.

The Maryland Steel Co. entertained a large party of guests, including many prominent engineers and railway men on the occasion of the launch of the propeller "Alabama" for the Baltimore Steam Packet Co., on Oct. 1. On the same day a steel tug was launched from the same yards.

City departments to pay for gas used out of their several appropriations is the remedy suggested by the Director of Public Works of Philadelphia, Mr. James H. Windrim, to prevent waste. He says in his last report that over 587,000,000 cu. ft. of gas was used by the Philadelphia departments in 1891, an excess of 136,000,000 cu. ft. over the previous year. He suggests that economy in its use will only be enforced when councils shall provide by ordinance as above indicated.

A steel roller path for an 8-in. disappearing gun carriage has been cast for the U. S. Army by the Midvale Steel Co. The casting weighed, as shipped, 7,995 lbs. The specifications of the Ordnance Department, and the official tests of this casting, compare as follows:

	Ord. Dept.	Test.
Tensile strength.....	65,000 lbs.	73,000 lbs.
Elongation.....	20%	33.2%
" minimum.....	15%	
Elastic limit.....		35,000 lbs.
Contraction.....		47.18%

The record speaks for itself, especially in the elongation test.

The first 13-in. gun has had the last of its jackets slipped in place at the Washington Navy Yard, and is nearly completed. Its construction will consume about six months, but better time can be made with the other eleven contracted for. This gun with three others like it will find a place in the turrets of the battleship "Oregon" now building on the Pacific Coast.

Baltimore, Md., has a $6,000,000 loan ordinance just passed by the council. The mayor in his annual message says that the new bonds would be devoted as follows: For a new court house, $2,000,000; for modern pavements, $1,400,000; to continue the system of storm water sewers, $1,200,000; for new bridges, $600,000; for new school houses, $400,000; opening new streets, $300,000, and $100,000 for making a new topographical survey and maps of the city. The ordinance is now in the hands of the Committee of Ways and Means.

SEWAGE PURIFICATION IN AMERICA.

(Continued from p. 309.)

White Plains, N. Y., Continued.

The general arrangement and operation of the sewage purification plant at White Plains were described and illustrated in our issue of Sept. 22. Some interesting details remain to be noticed.

The screens for stopping the large particles in the sewage as it passes through the tanks are shown in detail by Fig. 18. There are two of these screens for each set of tanks, located as shown by Fig. 13 on the inset in our issue of Sept 22. They are made of ¼-in. wire, 1-in. mesh, swinging as shown in the illustration, to facilitate cleaning.

The details of the rolling covers for the tanks in the building are shown in section and elevation by Figs. 19 and 20. The covers are of tongued and grooved Georgia pine some 4 to 5 ins. wide by 2 to 2½ ins. thick. The cover for one set of tanks rolls on the top flange, and those of the other on the bottom flange of a 12-in. I-beam.

The method of supporting the rails for the sludge tramway so they will not interfere with the rolling of the tank covers, just described, may be seen in Fig. 21.

In order that the chemicals used as precipitants may be admitted to the sewage automatically and in fixed proportion, the mechanism shown in Fig. 22 is employed for the lime and that shown in Fig. 23 for the perchloride of iron. Each of these devices depends for its action upon the varying levels of the sewage in a tank which contains a float connected by a lever with a cock, all so arranged, as described below, that the chemicals will be discharged in quantities and at intervals as desired.

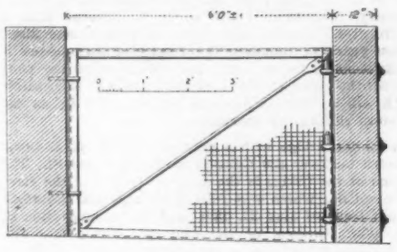

Fig. 18. Hinged Screen in Sewage Tank.

Both Figs. 22 and 23 are designed to illustrate the principles upon which the mechanisms work and not to show their exact arrangement at White Plains, although they do very nearly show the latter.

The lime is slacked in the lime tank, Fig. 22. Water is added to make a milk of lime which is fed into the sewage over the lip of the lime tank. Water is admitted to the lime tank through the pipe A which is supplied from an elevated tank on a hill through the pipe B and the feed cock. The water tank gives a pressure of 47 lbs. per sq. in. in the building. The pipe B is perforated at different levels, to cause the water to be discharged horizontally in order to stir up the lime, much of which would otherwise remain at the bottom of the tank.

The pipes A and B connect with the casing of the cock C, as shown in the two enlarged sections. The cock is inserted in this casing and is provided with longitudinal slots at regular intervals on its circumference, which are so arranged that whenever one of these slots opens against the contracted end of the pipe A another will open against the end of the pipe B and vice versa.

The float is connected with the plug in such a way, that when it rises the cock is not turned, but when it falls a pawl engages with a ratchet and turns the cock so when the float is half way down the slots come opposite each pipe and water is discharged into the lime tank and lime carried over the lip into the sewage. If the feed cock was opened with the rise of the sewage it is obvious that the slower the flow of sewage the greater would be the discharge of lime.

The device for admitting the perchloride of iron, Fig. 23, is slightly different in that it is designed to measure this chemical accurately and to draw it from a storage tank of considerable size. To do this the storage tank is connected through a three-way cock with a small measuring tank placed on a lower level. The port of the cock which connects directly with the measuring tank is larger than the others and is always open. The third port connects, when in the proper position, with a pipe having its lower end over the sewage tank. The cock is turned automatically by the rise of the sewage so that the measuring tank is always emptied when or just before the float and the sewage are at their highest level and at no other time. The sewage is at its highest level just before it is siphoned from the chamber to the large final settling tank, shown by the inset in our issue of Sept 22.

In preparing the perchloride of iron for use, the storage tank is first filled about half full of water, the desired amount of the chemical added and then the tank filled full. This method is followed to prevent injury to the valve. A 60% perchloride of iron is used, and two grains per gallon is considered a fair amount for ordinary sewage. The perchloride of iron is bought from Martin Kalbfleisch Sons Co., New York for 3½ cts. per lb., or about $4.75 per carboy.

The perchloride of iron is admitted to the sewage near the mouth of the inlet sewer and not at the end of the precipitation tank, as stated in our issues of Sept. 22 and 29 concerning both White Plains and Sheepshead Bay.

The probable chemical action caused by the addition of lime and perchloride of iron to sewage in the manner described has been given by Prof. J. H. Raymond, M. D., as follows:*

When the sewage enters the first tank it consists of: (1) Organic matter in solution. (2) Organic matter in suspension. (3) Chlorides. (4) Sulphureted hydrogen and sulphides. (5) Sulphates. (6) Carbonates, including ammonium carbonate resulting from the decomposition of urea. (7) Phosphates. (8) Other ingredients.

As a result of the addition of the milk of lime, the following changes take place:

The ammonium carbonate $(NH_4)_2CO_3$, is decomposed, and ammonia is set free.

The lime unites with the sulphureted hydrogen to form calcium sulphide, CaS.

The lime decomposes the sulphates, carbonates, and phosphates,—calcium sulphate, $CaSO_4$, Calcium carbonate, $CaCO_3$; and calcium phosphate, $Ca_3(PO)_2$ being precipitated. As these fall they carry with them the suspended organic matters. If magnesia salts are present in the water supply which is provided for moving the sewage, these will be decomposed, and magnesium hydroxide will be precipitated. Any iron and alumina salts will be decomposed by the lime, with precipitation of the corresponding hydroxides. Furthermore, it is probable that lime has a tendency to combine with and form insoluble compounds with the soluble albuminoids. All these would fall with the sludge. One of the important reasons for treating sewage with lime is to precipitate these suspended organic matters. They would, in time, without any chemical treatment, subside; but this would require so much time that before it was completed decomposition would take place, and, besides, enormous storage facilities would be necessary. These difficulties are obviated by hastening the precipitation by the addition of lime.

When the supernatant liquid passes into the second tank, its composition is, in the main, as follows:

(1) Organic matter in solution. (2) Chlorides. (3) Calcium sulphide and other sulphides. (4) Soluble oxides and hydroxides of bases, chiefly potassium, sodium, and ammonium, formerly combined with sulphuric, carbonic and phosphoric acids, together with the milk of lime, calcium hydroxide, $Ca(OH)_2$, which is in excess.

To this fluid, perchloride of iron, Fe_2Cl_6, is added, and, as the result, some of the soluble organic matters are coagulated and some are not affected.

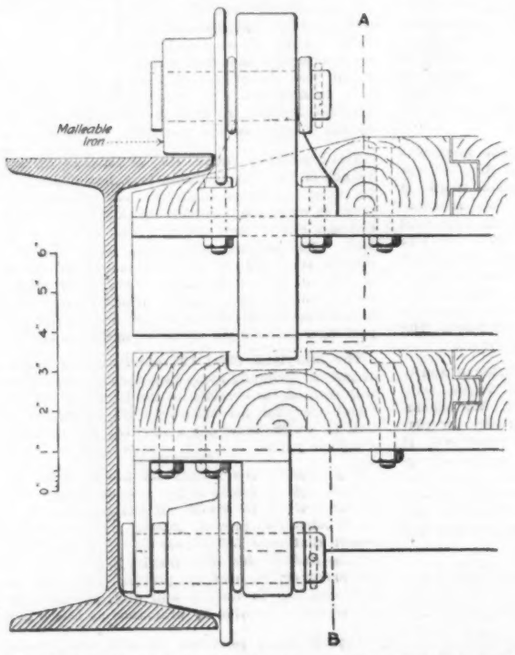

FIG. 19. CROSS SECTION THROUGH END OF PRECIPITATING TANK COVER.

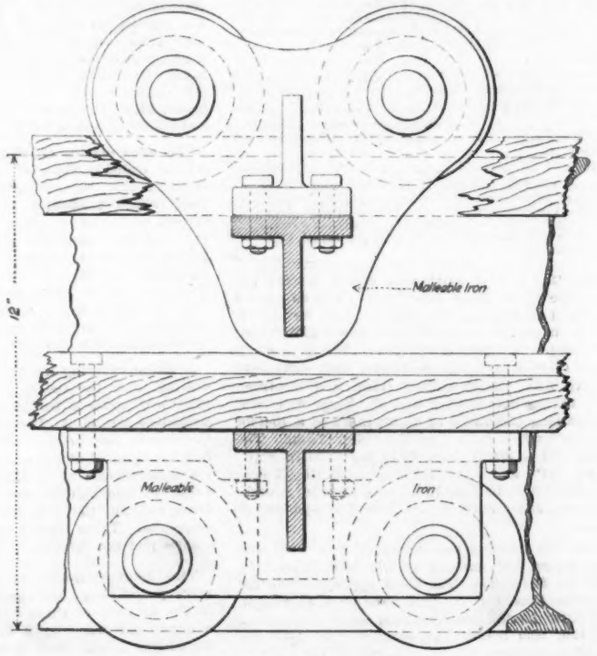

FIG. 20. SECTION AB.

* "Treatment of Sewage by Chloride, Precipitation and Sedimentation." By J. H. Raymond, M. D., Professor of Physiology and Sanitary Science, Long Island College Hospital.

The chlorides are practically unchanged.

The calcium sulphide is decomposed and iron sulphide is formed, and some sulphur is set free.

From the oxides and hydroxides of bases, ferric oxide is formed, and the bases are combined as chlorides.

From the excess of calcium hydroxide, ferric oxide is formed, and calcium chloride.

The effluent practically contains all of the above ingredients in solution, excepting the ferric oxide and such of the organic matters as are precipitated; these settle to the bottom of the second and third tanks.

It will be understood that the above is an abstract presentation of the case based upon sewage in general and not that of White Plains or any other locality; also that it presupposes the addition of perchloride of iron after the lime has had time to act upon the sewage. As such it is given without further comment.

In passing from a consideration of the use of chemicals, attention may be called to the fact that the lime is admitted intermittently to sewage which has a continuous flow and therefore some sewage may pass the series of chambers of the first tank to the weir over which the sewage flows to the first siphon chamber without receiving any direct addition of lime. Such sewage would have little or no precipitation to this point, but it would have sedimentation owing to the slow rate of flow. Since lime is discharged each time the first siphon works every discharge of sewage into the final settling tank will contain lime, the only question being whether it is well mixed with the sewage. It would seem preferable to discharge the lime into the sewage continuously, or nearly so. This might be effected by arranging the float and feed cock, Fig. 22, so that the water would be discharged into the tank with every few inches rise of the float, still maintaining

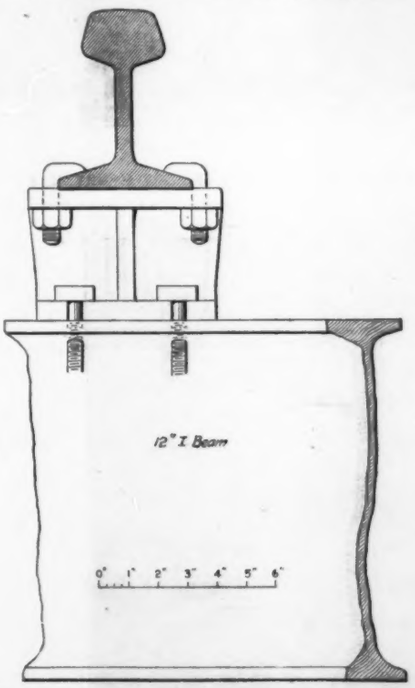

Fig. 21. Chair for Supporting Tramway Rail on I-Beams.

a fixed relation between the lime and sewage. Or better yet a constant flow of lime might be maintained and the quantity varied to correspond with the volume of sewage by slowly passing the latter through a rectangular trough containing a lever-float which, rising and falling with the volume of sewage, would regulate the flow of lime through a feed cock. The advantages of having the lime thoroughly mixed with the sewage the moment the latter reaches the first tank are obvious.

The chlorine for deodorizing the sludge, or for treating the total volume of sewage if desired, is made from common salt, black oxide of manganese and sulphuric acid. The salt and black oxide of manganese are mixed, 1 to 1, in a tray above the chlorine generators, and washed down into the generator with 2½ parts of water. The cocks being turned to allow the chlorine to pass through the pipes and into the sewage tanks, sulphuric acid is then slowly admitted to the tanks and the chlorine generated. Acid should be admitted only in sufficient quantity to develop a pressure of 2 lbs., the pressure being indicated by a gage. A safety water column and safety gage are provided to keep the pressure down to 5 lbs., the blow-off pipe from the safety gage extending up through the roof of the building. In addition the covers of the tanks being treated should all be tightly closed, and it is well to have the windows and doors open. As inhalation of any amount of chlorine would be injurious to the nostrils, trachea and lungs, the precautionary measures mentioned are advised on the printed directions for the generation and use of the chlorine and the safety

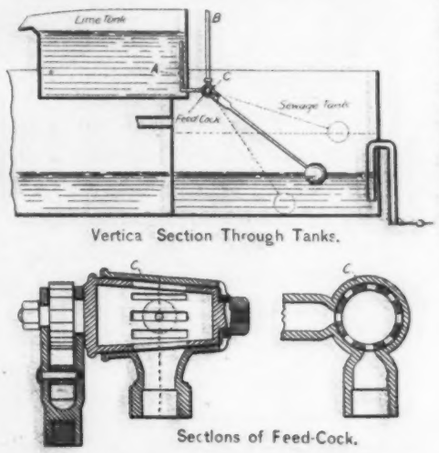

Fig. 22. Automatic Feed-Cock From Lime Tank.

gage is made a part of the plant. In practice, however, no trouble with the chlorine is experienced. It is obvious that since the chlorine is used to disinfect sludge or sewage it will be admitted to the tanks only when the perforated pipes are submerged, and if the chlorine should pass up through the sludge it would at once make the fact known, whereupon the acid could be turned off from the generators. In practice it seems probable that a deficiency rather than an excess of chlorine will find its way to the tanks. It may be added that Dr. Raymond, quoted above, favors the introduction of the chlorine as the sewage enters, but this would mean continuous use, which might prove too expensive.

The capacity of the final settling tank is about 27,500 gallons and of the small siphon tank or chamber which empties into it about 2,000 gallons, allowing for the sewage which flows into the latter while it is discharging. The sewage travels about 150 ft. in the first or precipitating tank and 50 ft. in the final settling tank, making 200 ft. in all.

The amount of sewage treated at White Plains early in September was said to vary from some 200,000 gallons or under per day to about 300,000 gallons, or less, for which about one barrel of lime and one carboy, 10 to 12 gallons, of perchloride of iron was being used.

There were early in September about 450 taps connected with the water-works and about 250 sewer connections, which, being taken to yield as much sewage as the consumption of water per tap, 780 gallons, would give 195,000 gallons per day of natural discharge into the sewers. If the above figures are all approximately correct only a small amount of ground water now finds its way into the sewers. When the plant had been in operation only a month, however, it is said that the daily flow through the tanks was 266,000 gallons. At that time there were but few sewer connections and the greater part of the flow must have been ground water. The tanks are sunk in the old bed of the Bronx River, the river having been turned when the Harlem division of the New York Central R. R. was built, and at first there may have been some seepage into the tanks.

To operate the plant an engineer and a laborer are required during the day and a watchman at night. About one ton of coal a week is consumed in generating steam. The coal costs $6 per ton, delivered.

The contract price for the purification plant alone, without allowance for superintending construction, was $50,049. This was increased about $3,000 by errors in grade which necessitated the lowering of the foundations, but should not be charged to the cost of purification.

No analyses of the sewage after purification have been made, to the writer's knowledge, and as the plant has been in operation but a short time little can be said regarding the results obtained. At the plant nothing objectionable could be seen or smelled and everything seemed to be in good shape.

At the outlet into the river the effluent was somewhat clouded, which might have been due, in part at least, to the lime used. For several hundred feet down the river some of the finer particles of sewage were deposited in shallow water having little motion. In places these deposits were 3 to 4 ins. deep, but they gave off little or no odor upon being stirred. The deposits may have been the result of improper management of the plant, especially too infrequent cleanings, which, as has already been stated, have thus far taken place but once a month. It may be that the lime does not become thoroughly mixed with the sewage, for the reasons mentioned above, in which case imperfect precipitation might be expected. In this connection it should be remembered that in constructing and operating sewage purification plants the controlling factor is the degree of purification desired. This decided, the next question is how to obtain it at the least possible expense. The large and

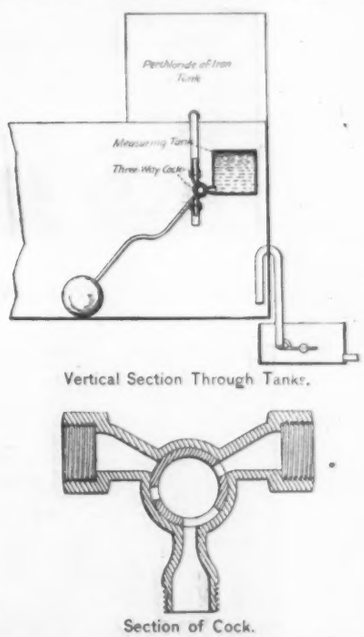

Fig. 23. Automatic Three-Way Cock for Perchloride of Iron Tanks.

inoffensive pile of sludge outside the purification building at White Plains witnesses that a great amount of pollution has been excluded from the Bronx River and rendered harmless. The deposits of sewage in the river gave no offense early in September, even when stirred, and it is possible that the chlorine treatment had to a large extent rendered the deposits unobjectionable so far as decomposition is concerned.

NOTES FROM RECENT WATER-WORKS REPORTS.

The consumption of water in 1891 at Yonkers, N. Y., in 200 private residences, with modern plumbing, sewer connections and hose for sprinkling, but without stables, averaged 165 gallons per residence, or about 30 gallons per head. The water all passed through meters. The average daily consumption per capita for the whole city was a little less than 70 gallons, and per consumer about 76 gallons. The average use of water by all domestic consumers was 45 gallons per day. Of 2,060 metered consumers who used water all the year, 11% paid the minimum rate of $4 per year for 1,000 cu. ft. or less, or about 12,000 gallons per year. About two-thirds of the 2,060 consumers paid not over $20 per year.

AN ECONOMICAL SYSTEM OF HANDLING EARTH.

In our issue of April 18, 1891, we illustrated a new method for unloading earth from flat cars which had been put into use by Messrs. Drake & Stratton in work on a large contract on the Delaware & Hudson Canal Co.'s R. R. Since that article was published the "rapid unloader" there described has come into quite extensive use, and the advantages obtained by it have been found to be very important. We give herewith some views reproduced from photographs recently taken, illustrating the work carried on by Messrs. Drake & Stratton.

Fig. 1 shows a Barnhart steam shovel at work loading cars at a pit about a mile from Port Henry, N. Y.

The cut shows well what coarse material can be excavated by a strong and well handled steam shovel. The great bunch of scraggly roots which it has just grubbed up with ease and is about to dump on the car is good evidence of this, and other evidence is furnished by the large pieces of rock which are being plowed off the cars in Fig. 4.

Chief interest, however, centers in the method of unloading. Between each two cars is an apron of steel plate lapping over the space between the cars and hinged to one of them. This makes a practically continuous floor from one end of the train to the other, and over this floor from the rear end of the train to the front a plow is drawn, forcing the load over either or both sides of the car, according to the type of plow used.

The common method of unloading by plowing off is to secure the train by the brakes wherever the load is to be dumped, uncouple the locomotive, and string a cable along the train, connecting one end of the plow on the rear car and the other to the locomotive. The locomotive is then started and hauls the plow along the train to the front end. The practical disadvantage of this is that it takes a greater amount of traction to plow off a well loaded train than an ordinary locomotive, such as is com-

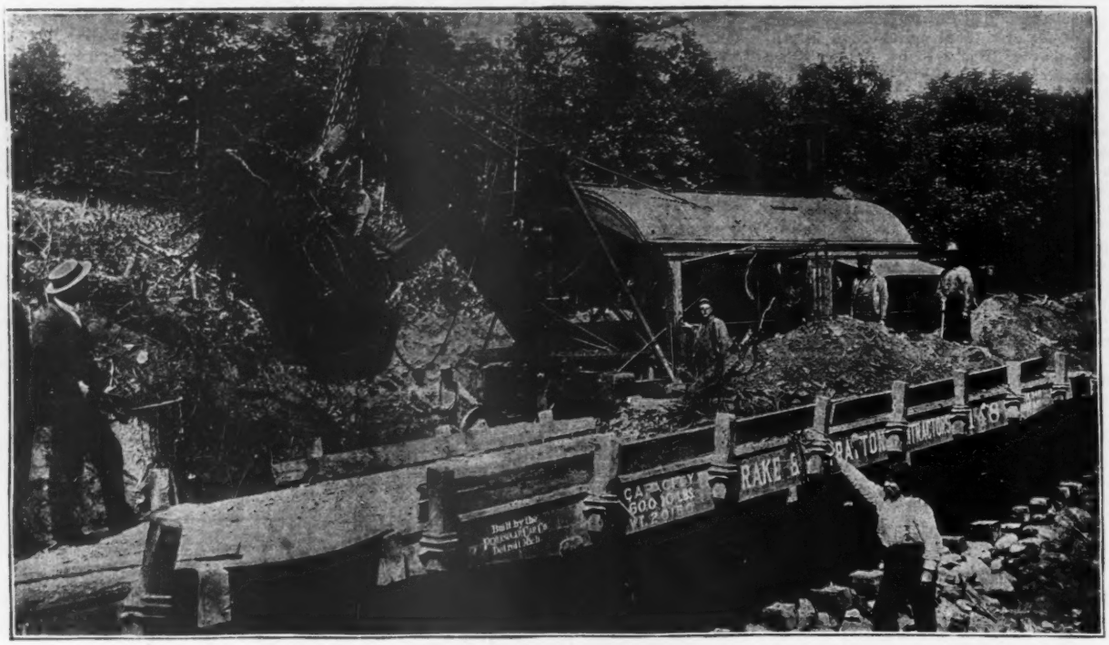

FIG. 1. BARNHART STEAM SHOVEL LOADING CARS IN PIT ON DELAWARE & HUDSON CANAL CO.'S R. R., ONE MILE FROM PORT HENRY, N. Y.

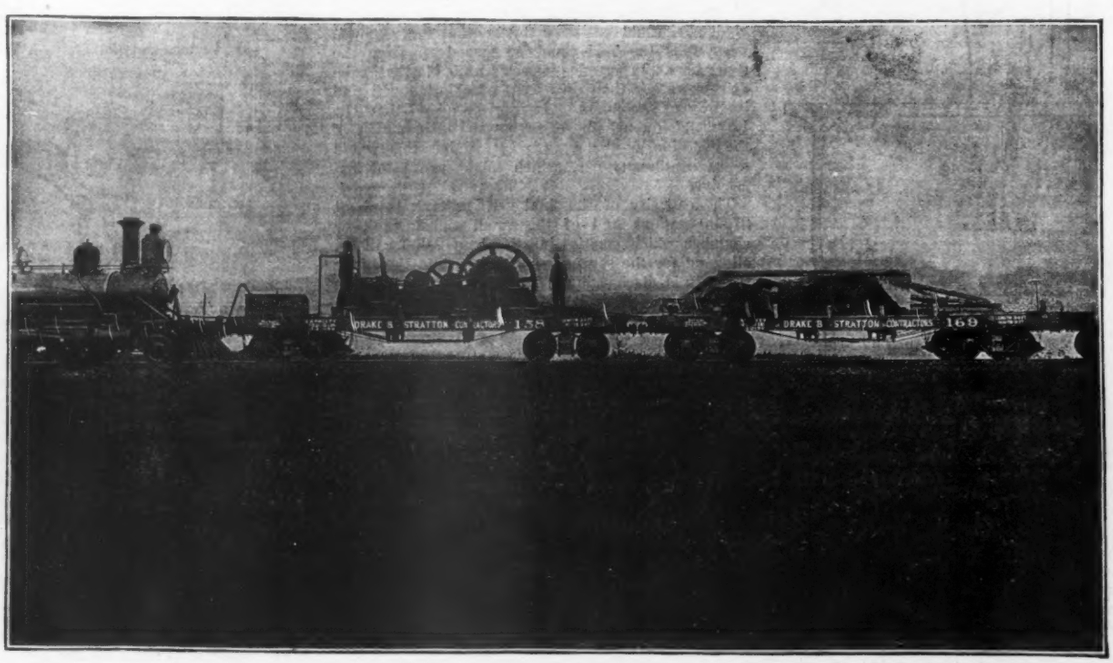

FIG. 2. LIDGERWOOD "RAPID UNLOADER" FOR DRAWING UNLOADING PLOW OVER THE TRAIN.

monly used for construction train work, can exert. When the locomotive cannot start the plow on a straight pull, the practice is to back up one to three car lengths and get a start ahead. Naturally, something has to yield in such a case, but it is not always the dirt in front of the plow. Experience shows that this method is very fruitful of breakages. It was an aggravated case of this sort which led to the first use of the rapid unloader.

In grading for 17 miles of second track on the Delaware & Hudson, near Whitehall, N. Y., in the winter of 1890-91, Messrs. Drake & Stratton found unusual difficulty in plowing off the trains. The material was chiefly clay and it would freeze so stiff in hauling from the pit to the dump, that the heaviest mogul locomotive on the road could not haul the plow. With two locomotives the brakes would not hold the train and it had to be chained to the track, with more or less resulting breakage. To meet this difficulty the Lidgerwood Mfg. Co. were asked to build a special winding engine to be placed on the first car of the train to do the work of hauling the plow.

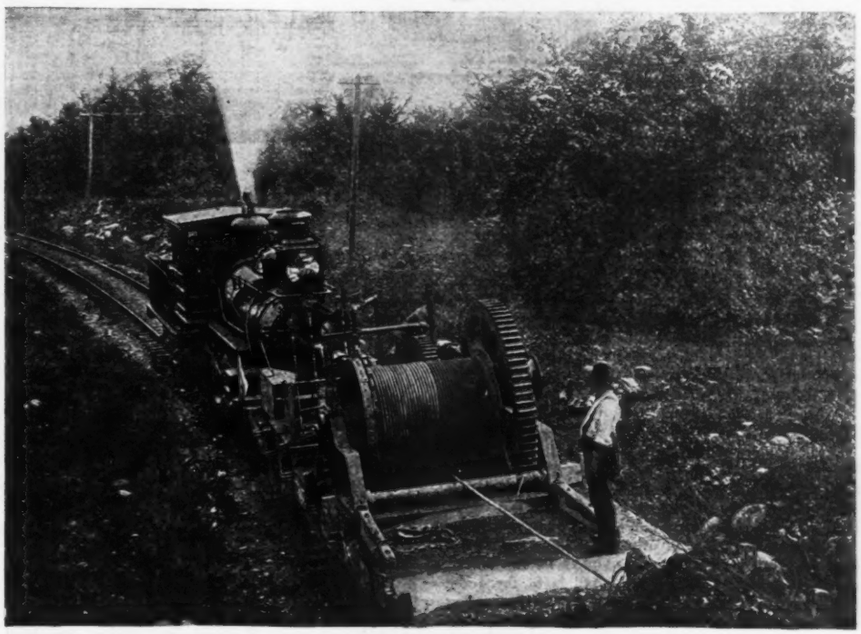

FIG. 3. "RAPID UNLOADER" AT WORK, CABLE PARTLY WOUND ON DRUM.

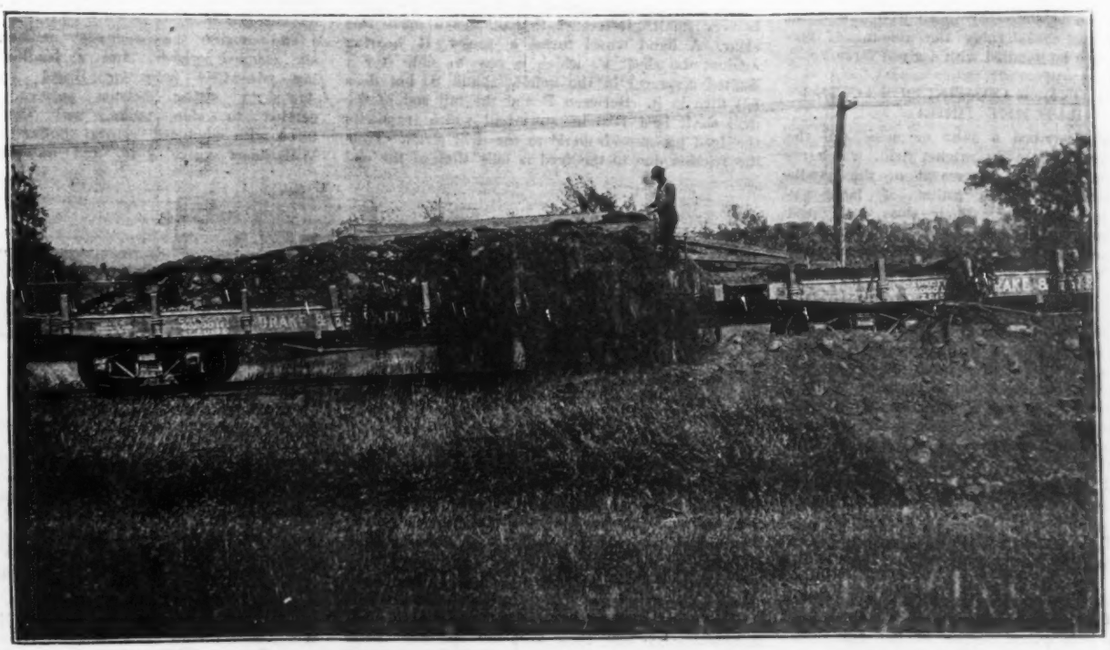

FIG. 4. UNLOADING PLOW AT WORK.

This "rapid unloader," which the Lidgerwood Co. now offers as a standard article of manufacture, consists practically of a Lidgerwood hoisting engine with two 10×12 in. cylinders. These drive a shaft carrying a pinion which meshes with a large gear-wheel fast on the same shaft with a 42-in. drum. The ratio of the gearing is such that with the ordinary locomotive steam pressures the winding engine can exert a pull of 25 tons on a cable wound on the drum, while hauling it in at the rate of 125 ft. per minute. The drum is grooved for a 1⅛ in. cable, and plow steel wire is used as its material, giving it an ultimate strength of 50 to 60 tons. The total weight of the unloader is 24,500 lbs. It is securely bolted to the floor of the car, and when exerting a pull there is no tendency to move the train on the track, but only to crowd the cars closer together. Setting the brakes, therefore, which was a necessary preliminary to plowing off by the old system, is unnecessary.

The steam for the unloader is taken from the locomotive boiler through a 2-in. pipe with flexible joints, as shown in Fig. 2, to allow for motion between the locomotive and the car.

It may be of interest to trace the routine followed with this system of handling earth as exemplified by some of the work of Messrs. Drake & Stratton on a recently completed contract. The work was the filling of a trestle ¾ mile in length across South Bay, near Whitehall, N. Y. The material was taken from a sand bank near Dresden, about five miles distant. The plant used consisted of three locomotives, about 50 flat cars, a Barnhart steam shovel, a Lidgerwood rapid unloader, and an unloading plow built by the Marion Steam Shovel Co. At the bank a locomotive called a "spotter" shifts the empty cars in position for the shovel to fill and makes up the filled cars in a train. About two hours are required to load a train of 17 cars, each having about 12 cu. yds. A second locomotive hauls this train to a siding about ¾ mile from the trestle and takes the empty cars back to the pit. The third locomotive makes up the filled cars into a train with the plow at the rear and the rapid unloader at the head. At this siding there is a simple derrick, the boom of which can be swung around over the track. The train is brought into position with this boom over the drum on which the cable is wound and the end of the cable is attached to the boom. The train then pulls ahead for its length, the cable is paid out as it moves and is stretched along on top of the loaded cars. The end of the cable is attached to the plow and the train is then ready to start for the trestle. There is a telegraph station at this siding in communication with the train dispatcher's office. If the road is clear, the loaded train is pulled to the trestle, and when at the proper point the cable is wound in and the material on the train is plowed off. It requires 20 to 30 minutes for the train to go to the

trestle, unload and return to the siding. The actual unloading takes 5 to 6 minutes. The number of train loads hauled is about 4 per day.

Another piece of work done by the same contractors is the hauling of gravel for ballast from a bank near Castleton, to be used at a point about 40 miles distant. Here good train loads are important to economy. The cars used were specially made for Drake & Stratton, by the Peninsular Car Co. They have floors 9 ft. wide and 34 ft. long. Their capacity is 60,000 lbs. and with 8-in. side boards each will hold 19¼ cu. yds. They have the brake shafts placed on the sides instead of the ends so as not to interfere with the movement of the plow. The point of the nose of the plow curves up slightly, so that it will not catch on the aprons between the cars in passing over the train. The plow is 48 ins. high and about 32 ft. long. After plowing off, the apex of the pile of dirt is about 12 ins. outside the edge of the car; this is far enough to ensure that all the dirt will be clear of the rails.

Among other advantages of the rapid unloader is the facility which it offers for placing the material where it is wanted. For example, in hauling ballast long distances well loaded cars may contain sufficient material for two train lengths. To distribute it over this distance the train is started ahead when the unloader begins to haul in the cable and at the same rate of speed. Suppose on the other hand it is desired to fill a trestle across a deep, narrow gully. The train may then be backed when the hauling in commences and the whole train load can be dumped at one spot. The saving in time and the certainty and safety with which the unloading is done are also important points in its favor, as it is generally necessary to obstruct the road as little as possible by work trains.

The cost of trestle filling with loading, hauling and dumping all done by steam power is reduced to such figures that hundreds of miles of existing trestle can be filled more cheaply than they can be kept in repair. On some of the work on the Delaware & Hudson Canal Co.'s R. R., above described, from 700 to 900 cu. yds. have been handled daily with a working force of but 30 men. The method of unloading above described is stated by those who have it in use to increase considerably the amount of material which can be handled with a given force.

THE SCHUTTLER CONTINUOUS-ACTING RATCHET DRILL.

We briefly described a year or more ago the Schuttler continuous-acting ratchet drill, which rotates continuously with movement of the handle in both directions. The value of labor-saving tools is something which does not need demonstration, in this country at least, and the advantage of a tool which does a given amount of work with half the motion ordinarily required is obvious.

Since we first described the tool considerable changes have been made in its construction. The fault which is often found with devices of this sort is that they get out of order or wear out faster than the less complicated tools, but by properly designing each part to suit the work it has to do this objection can be overcome. We have taken one of the Schuttler drills apart and carefully examined its working parts. They appear to be of ample strength and there seems every reason to expect the machine to prove durable in service and not likely to get out of order, the more so as the working parts are all inclosed in a malleable iron case which protects them from blows and from the action of grit.

Fig. 1 is reproduced from a photograph of the working parts of the drill removed from the case, and Fig. 2 is a longitudinal section of the drill. The ratchet wheel A is fast on the drill shaft. The ratchet wheel B is loose on the hollow shaft S. The small bevel gears C and D turn freely on pins fixed in the hollow shaft S, perpendicular to its axis. It will be noticed that the ratchet teeth of A and B face in opposite directions. The case in which the working parts are placed carries two pawls, which engage with A and B respectively. The working lever is attached to this case and when the case is turned in one direction the ratchet wheel A turns with it. When turned in the opposite direction the other pawl engages with the wheel B and that is turned with the case. Now the wheels A and B are each in gear with the small bevel gears C and D, and hence if C and D are free to turn on their pins (but not to revolve as a whole), turning A will cause B to turn in the reverse direction, and vice versa. In working the drill the square shank of the shaft S is held from turning by the socket of the feed and so the bevel gears C and D can only turn on their pins and not as a whole. Thus moving the drill

FIG. 1. THE SCHUTTLER CONTINUOUS ACTING RATCHET DRILL. CASE REMOVED TO SHOW WORKING PARTS.

lever in one direction turns the gear A, and movement in the opposite direction continues the motion of A in the same direction, driving it by the wheel B and intermediate gears C and D.

A feature of the drill of great importance to its easy working is the method adopted for feeding it up to its work. The ordinary plan is to force the drill shaft forward by a hollow screw shaft bearing against a collar on the drill shaft. The friction due to the pressure of the feed is therefore exerted at a considerable distance from the shaft center, and when the drill is crowded hard this friction absorbs a large part of the power exerted. In the Schuttler drill the feed pressure is exerted at the center of the shaft and the leverage of such friction as exists is very small. Reference to Fig. 2 will make this clear. A hand wheel turns a screw R bearing against the shaft P, which is free to slide (for a limited distance) in the hollow shank S, but does not turn in it. Between P and the tail end of the drill shaft is a 7-16 in. steel ball which transmits the feed pressure from P to the drill shaft. Thus the friction due to the feed is only that of the end

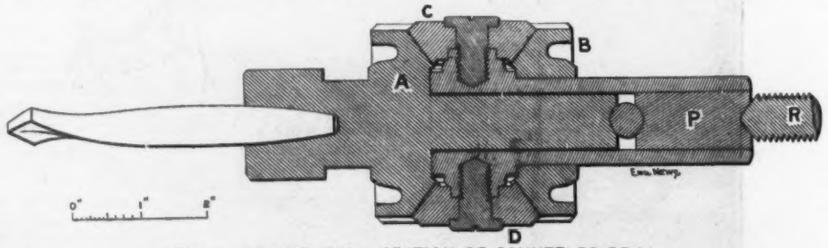

FIG. 2. LONGITUDINAL SECTION OF SCHUTTLER DRILL.

of the drill shaft turning against the ball. It will be seen that the reason for the use of the ball in this place is not to substitute rolling for sliding friction, as is ordinarily the case with ball bearings. The reason why a ball is better than a hemispherical pivot on the end of P is that a fixed pivot soon wears out of shape, and cuts the end of the shaft, but a ball can turn so as to present constantly new surfaces for wear, and (especially in a tool used intermittently) will thus keep its spherical form perfectly. It is also to be noted that this form of feed bearing is so much better protected from grit than the ordinary pattern that it should have a further great advantage over it.

The drill appears to be well made as well as correctly designed. The gears are cut from tool steel and the teeth of the ratchet wheels are of extra height, giving ample margin for wear. The shell is made of malleable iron and the two halves are ground on the face so that they make a tight joint when clamped together and prevent the entrance of moisture and grit. The weight of the drill with working lever and half-twist drill in place is 10 lbs. The rail clamps and feed mechanism supplied with it for use as a track drill weigh about 20 lbs.

The track drill attachments hook onto the bottom flange of the rail and do not interfere with passing trains. The feed carriage slides on a bar so that all the holes for a joint can be drilled without moving the rail clamps.

For track work the drill has met a very favorable reception and is now in use on over 60 railways. It seems probable that in locomotive erecting shops and similar places its use would be even more advantageous than on track, as drilling has often to be done in very cramped quarters, where the fact that motion in both directions counts will greatly expedite work. The Car Truck Supply Co., of Chicago, the manufacturers of the drill, are now getting out a drill especially for machine shop work.

AN IRISH NARROW GAGE LOCOMOTIVE.

A narrow gage engine, burning liquid fuel, has been built recently by the Hunslet Engine Works, of Leeds, England, for the Tralee & Dingle Railway, in Ireland. This is a light railway of 3 ft. gage, with a maximum grade of 3.33% over five miles long, on which occur curves of 198 ft. to 660 ft. radius, where the line runs along the side of the mountain. The railway is 31 miles long, the track laid with 45-lb. steel rails, and the average weight of train 134,400 lbs. On account of the large fuel consumption and consequent expense, fuel being more expensive than in England, the engine has been fitted with the liquid fuel apparatus designed by Mr. J. Holden, Locomotive Superintendent of the Great Eastern Ry., of England, and described in our issue of March 14, 1891. An article on "Petroleum Fuel for Locomotives" was published in our issue of Aug. 25, 1892.

The engine has outside inclined cylinders, six coupled wheels, and a leading and trailing two-wheel pony or Bissel truck of the American swing bolster pattern. Water is carried in side tanks, and the engine is fitted with combined central buffer and coupler, Walschaert valve gear, and automatic vacuum brake acting upon cast iron brake blocks which bear upon the tread and flange of the six driving wheels. A wire spark arrester is fitted between the top of the exhaust pipe and base of smokestack. There are four sand boxes, fitted with the Gresham & Craven sand jet described in our issue of Feb. 13, 1892. The leading dimensions and particulars of the engine are as follows:

Driving wheels, diam.	3 ft. 0½ in.
Truck wheels, "	2 ft. 0 in.
Wheel base, driving	8 ft. 9 ins.
" total	20 ft. 8 ins.
Weight in working order	71,681 lbs.
" empty	50,360 lbs.
Cylinders	13½ x 18 ins.
Boiler, diam.	3 ft. 6 ins.
" length of barrel	8 ft. 9 ins.
Boiler pressure	160 lbs.
Firebox, copper	6 ft. 0½ ins. x 1 ft. 9¼ ins.
Grate area	10.7 sq. ft.
Staybolts, copper; diam ⅝ in.; pitch	4 ins.
Tubes, brass; diam. outside, 1⅝ in.; number	138
Tubes, thickness, 12 W. G. at firebox end, and 14 W. G. at smokebox end.	
Heating surface, tubes	531 sq. ft.
" firebox	70 sq. ft.
" total	601 sq. ft.
Capacity of tank	900 gallons.
Capacity of fuel space (for coal and 106 gallons of oil)	30 cu. ft.

THE DISPOSAL OF REFUSE.*

The waste products chiefly dealt with are those at present coming under the administration of local authorities, comprising ash-bin refuse and market garbage, fish, and other offal, street sweepings, excremental matter, and manufacturers' refuse (the latter term being substituted for "trade refuse" in order to discriminate between shop and market refuse, and the waste products of manufacture). Slop-water and surface drainage do not by themselves present any great difficulties in disposal; but they are referred to in passing.

Table I. and II. cannot be considered of much value, except as disclosing the difficulties of arriving at any definite figures in respect of the quantities of refuse produced by a given population. Lack of uniformity in the statistics is the principal difficulty. Amounts of refuse recorded in loads have been excluded from the tables, as no estimate of the weight is possible, the carts often arrive half empty; but there is difficulty in eliminating such sources of error as are due to a mixture of system (partly water carriage and partly collection), which exists in most towns. Again, in the absence of information to the contrary, some amount of trade refuse may be included.

Table I.—Towns Collecting Excrement and Ashbin Refuse Together.

Name of town.	Time and date of record.	Population concerned.	Total refuse in ashbin and privy stuff.* tons.	Total refuse in tons per annum per 1,000 inhabitants.
Rochdale	Four weeks ending Oct 3, 1890	72,000	1,745	315
Preston	Year ending Oct., 1888	79,000	35,674	450
Gorton	Year 1888	40,000	14,654	366
"	Year 1889	40,000	14,084	367
Bolton	Year 1886	109,000	46,704	451
Manchester	Year 1889	380,000	190,245	500
Total				2,429
Average				405

* Does not include street sweepings.

Table II.—Refuse of Towns with Separate System of Removal for Excrement.

Name of town. or district.	Time and date of record. Year.	Population concerned.	Ashbin refuse, market garbage, offal, etc., in tons per annum.	Ashbin refuse, tons per market 1,000 garbage, inhabitants etc., in per annum.
Paddington	1886	112,000	20,690	184
Derby	1886	92,000	11,900	129
Edinburgh	1890	236,000	90,000	381*
Battersea	1890	200,000	24,000	120
Leeds	1889	310,000	90,000	277*
London	1890	4,221,000	750,000	178

* This includes a considerable amount of excrement.

Mr. W. Till, in a valuable paper read before this Association,* gave the sewage of the Birmingham drainage district as 16 million gallons per 24 hours from a population of 619,700=26 gallons per head per day. From this amount 135,476 cu. yds. of sludge were precipitated.

Mr. Bennett** gives the sewage from a population of 13,000 at Southampton as one-half million gallons per 24 hours = 38 gallons per head per day. The sewage of Royton, with a population of 21,000, has been computed at one-half million gallons per 25 hours = 24 gallons per head per day. The sludge was estimated at 25 tons from the whole. From these figures it would appear that nearly 30 gallons per head per day may be reckoned upon, which would produce about 3.36 lbs. of sludge. It must be remembered that the sludge contains other ingredients in addition to excrement, which was found by careful records made in Rochdale, 1889, to be nearly 12 ozs. per head per day.***

Take the average of Table I., the total refuse collected, including excrement, but exclusive of street sweeping, amounts to about 400 tons per annum per thousand of population.

At Bolton, in 1886, the street sweepings amounted to 9,114 tons for a population of 109,000**** = 84 tons per 1,000 inhabitants. The amount of street sweepings, probably, varies more in different towns than any other class of refuse, and is often taken to be a much larger quantity than the above. If it is put at 100 tons, then the total refuse of all classes from a town on the collection system, amounts to 500 tons per 1,000 inhabitants per annum (which does not include detritus from surface water, slop-water, nor manufacturers' refuse).

The above figures give a rough idea of the amounts of refuse which have to be dealt with; and of the magnitude of this Herculean task before which the cleansing of the Augean stables passes into insignificance.

The methods of disposal of the various kinds of refuse now generally adopted are in most instances incomplete, wasteful, and injurious to the public health. They may be briefly described as follows:

Method I.—Putrefaction.

In this process the refuse is dumped on vacant ground, often in the neighborhood of inhabited houses; and the practice cannot be too strongly condemned. That it is exceedingly detrimental to health can be open to no dispute; but although medical officers of health and sanitary authorities, generally, have urged its abandonment for many years, it is only now, when in most towns all available waste spaces, quarries, and pits, have been filled up, that sheer necessity has driven local authorities to another method of disposal.

Early nomadic races moved from camp to camp, leaving their refuse behind them. It remains for that which was described the other day as "this so-called nineteenth century" to pile up its heaps of putrescible matter in the midst of its dwellings, and leave them there to undergo the only possible change, viz., decomposition. According to the report of its health superintendent, in February, of this year,* Manchester is one of the greatest sinners in this respect, and the corporation is now contemplating the purchase of an estate of 1,800 acres, in Nottinghamshire, for the disposal of refuse.** The scheme is to continue to let the land to farmers, who, it may be presumed, will be forced, under penalty of notice to quit, if force is found to be necessary, to use nightsoil as manure in large quantities. In the opinion of the author it is high time that steps be taken to regulate the use of human excement as manure for cereals and market garden produce.

In Bristol the ash heaps have recently formed the subject of bitter controversy, and several private citizens have subscribed to pay the cost of a report by Mr. Charles Gritton, C. E.,*** which certainly lacks nothing in force. An examination of samples of this refuse was made for him by Messrs. Stanger and Blount, whose analysis is given in Table III. It may

Table III.—Analysis by Messrs. Stanger and Blount, C. E., of Refuse Recently Tipped at Bristol.

	Per cent.
Moisture	31.5
Non-putrescible-carbonaceous matter, cinders, wood, paper, straw, etc.	25.5
Putrescible organic matter*	11.0
Mineral matter (ash)	32.0
Total	100.0

* Of this quantity 5.7 per cent. was nitrogenous organic matter.

be here mentioned that according to Mr. William Booth Scott, C. E., "Excavations made in Boston (U. S. A.) in land filled from city carts 10 years previously, have disclosed remnants of organic matter, and the process of decomposition still going on."****

What can be said of these authorities who persist in thus disposing of their refuse, but that, to re-quote a quotation which will soon be familiar in this connection: "Their offence is rank—it stinks to heaven."

From returns obtained by Mr. Nowell Parr ***** out of 93 towns, 37 dispose of their refuse entirely by tipping. The cost is not in favor of the system. Camberwell pays 2s. 3d. per load for the first three months of the year, and 2s. 8d. for the remainder (a load being about 25 cwt.)—not including collection. Kensington is paying 1s. 11d. per load for barging; the entire cost of collection and disposal being 8s. per load. In 1890 Newcastle is said to have paid 2s. 6d. per ton for the "tip" alone.

Method II.—Utilization.

(a) Sorting.—The system of sorting in use at Chelsea has been ably described by Mr. Joseph Russell, who deals exhaustively with house-dust refuse.† He gives the composition of the material (as the result of five years' experience in London), which is set forth in Table IV. It is stated that nine-tenths of the material is sorted without being touched by hand, and the remaining one-tenth only after it has been well dusted by currents of air. The author has had the pleasure of inspecting the machinery at Lots-road, which is very cleverly designed for its purpose. (See "Engineering," vol. li., page 500).

Mr. Wolcott C. Foster describes a somewhat similar system,‖ but if anything more elaborate, which is in use in New York.

In unpleasant contrast to the excellent mechanical arrangements above referred to is the crude sorting system carried on under a contractor at Letts' Wharf, the City of London Depot, where, according to Mr. William Booth Scott, C. E.,‖‖ 70 persons, chiefly women,

Table IV.—Composition of London "Dust."
Average weight per load = 19 cwt. 20 lbs. net.

Component parts.	Average per 1,000 loads. tns.	cwt.	qr.	lbs.	Per-centage of whole (by weight).
Breeze (cinders and ashes)	611	3	0	4	63.69
Fine dust	187	1	0	8	19.51
Vegetable, animal and various mineral matter	44	3	3	20	4.61
Waste paper	41	1	1	20	4.28
Straw and fibrous material	30	18	1	6	3.22
Bottles (number 5,000)					=0.96
Coal and coke	8	0	2	14	0.84
Tins	7	11	2	22	0.79
Crockery	5	5	0	0	0.55
Bones	4	12	1	1	0.48
Mixed broken glass	4	11	2	2	0.47
Rags	3	15	3	16	0.39
Iron	2	0	0	20	0.21
Total					100.00

were employed (1884) in sorting: "Standing in the midst of dust piled up to their waists, with face and other extremities begrimed with refuse, they breathe a foul, moist, warm atmosphere."

The products of their labor are indicated in Table V.

Table V.—Value of Materials Sorted from City of London Refuse, at Letts' Wharf.

Scrap iron	25s. to 30s.	per ton
Rags	20s.	"
Bones	50s.	"
Inferior iron	20s.	"
Metal (various)	18s.	per cwt.
Tinware	3s.	" cartload
Corks	1s.	" bushel
Bottles (whole)	9d.	" gross

The danger that may arise from imperfect methods of sorting was exemplified in the case of a contractor who was summoned before a London magistrate in 1885* for sifting dust refuse and ashes on a wharf close to St. Mary's Hospital, in a manner injurious to health. Overwhelming medical evidence showed that particles of dust and germs of organic matter were blown into the wards of the hospital, causing the nurses and doctors to have sore throats, and hindering the healing of the patients' wounds.

The sorting of refuse appears to be a remunerative business in the metropolis, but it must be remembered that the authorities have to pay for its disposal, and that the immense brickmaking industry carried on within easy reach of the depots by barge and otherwise, makes a very good demand for breeze and ashes. The cost may be judged from the fact that the Fulham Vestry received an offer to treat their refuse in this manner for 1s. 6d. per load, or, say 1s. 3d. per ton, and they were to erect the plant and receive 3½ per cent. on the capital outlay.

(b) Manure Manufacture.—Processes to render possible the utilization of refuse as manure have been, and are being, carried on in many places, but principally in towns where excrement is collected from door to door.

The Vestry of St. Mary, Newington, mix stable manure and "soft core," or garbage, with slop and road sweepings, and sell the product, which is known as "Newington mixture," for 3s. per ton in summer and 2s. 9d. in winter, and thereby cover completely the annual outlay for scavenging. Manchester, according to Mr. C. J. Lomax,** is losing about £54,788 yearly by its drying process of manure manufacture at Holt Town and Water St. Mr. Wm. Bowler*** has suggested that manure could be made by mixing peat dust with pure nightsoil (as from the Manchester pails), and sufficient common vitriol to fix the free ammonia. He says 2 cwt. of acid costing 4s. is sufficient for 1 ton of peat dust, the whole costing 6s. per ton. From this 5 tons of manure could be produced by adding the nightsoil. The net cost would be about 2s. per ton, including labor. Analyses are given in Table VI.

At Halifax the Goux system is in operation, the principle of which is to line the pails with absorbent material, such as shoddy, sawdust, flax, street-sweepings, spent tan, etc.; and the stuff is stored in large sheds until wanted. Mr. Lodge has invented a machine for treating ashbin refuse, and afterward mixing it

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* Paper read before the British Association by Mr. G. Watson, of Leeds.

* Proceedings of the British Association, 1886, page 499. W. Till, on Birmingham, Tame, and Rea drainage.

** Paper read before the Institution of Mechanical Engineers, July 27, 1892.

*** "Collection, Treatment and Disposal of Town Refuse," by C. J. Lomax, 1892, page 33.

**** Report on the "Destruction of Towns' Refuse to the Local Government Board," by Thos. Codrington, C. E., 1888.

* Manchester "City News," July 9, 1892.

** Manchester "Guardian," Feb. 2, 1892.

*** Bristol "Mercury," June 22, 1892.

**** "Cleansing Streets and Ways in London and Other Large Cities," by William Booth Scott, C. E., 1884.

***** Paper by Nowell Parr, M. Inst. C. E., read before the Birmingham Association of Civil Engineers, 1892.

† A paper read before the Sanitary Institute, by Joseph Russell, C. E., Feb. 10, 1892.

‖ "Disposal of Town Refuse and of Garbage." By Wolcott C. Foster, of New York. ("Engineering," Dec. 18, 1891.)

‖‖ "Cleansing Streets and Ways in London and Other Large Cities." By W. Booth Scott, C. E., 1884.

* "London Standard," Oct. 31, 1885.

** "Collection, Treatment, and Disposal of Town Refuse," by C. J. Lomax, 1892.

*** "Chemical Trade Journal," Aug. 15, 1891.

with excrement, which appears to be very successful at Halifax.****

At Rochdale, by a drying system, the excrement is reduced to about 7½ per cent. of its original bulk, in 11½ hours. To each ton of excrement is added 24 lbs. of sulphuric acid, which fixes the ammonia and pre-

Table VI.—Analyses of Manchester Manure.

	Peat manure proposed by Mr. Bowler. dried	Holt Town manure.
Moisture	62.70	16.70
Organic matter*	26.25	36.05
Phosphate of lime	0.90	5.00
Carbonate	2.04	2.35
Undetermined	2.41	3.67
Silica	5.70	35.03
	100.0	100.0
* Containing nitrogen	1.25	2.38
Equal to ammonia	1.51	2.89

Table VII.—Cost of Collection of Refuse.

Name of place	Date.	Population.	System in use.	Cost per ton in pence.	First cost of closet complete.
Rochdale	1890	72,000	Pail system	91.45	£11
Preston	1890	105,000	Mixed	41.5	
Bolton	1888	109,000	Pail system	38.48	£10
"	1888	109,000	Privy and ashpit	20.87	
Halifax	1890	83,000	Goux system	36.9	
Gorton	1880	40,000	Privy and ashpit computed and 100 water-closets.	26.0	£10

vents its dissipation by the heat. The average yearly loss from this process is stated by Mr. Lomax to be £7,300, the price received for the manure being £10 per ton. These systems of manure manufacture are then, to sum up, generally unremunerative, and in some cases costly; they are always liable to break down when the demand for the manure ceases or declines; and the market varies from time to time, and according to the season of the year, while storage without causing a nuisance is impossible. The author is of opinion that the solution of the refuse problem is not to be found in this direction.

Method III.

Sending to sea, is, of course, only practicable for seaboard cities. New York "dumps" its refuse in the "lower bay," and there seems to be little satisfaction with the result. Liverpool, in 1891, barged out to sea 145,032 tons of refuse, costing, including loading into the barge, 1s. 6½d. per ton.* Gateshead and Sunderland are said to pay only 6d. to 7d. per ton for sending to sea. At Sunderland the River Wear Commissioners complain that thousands of old shoes, old hats, and tins are washing up on to the foreshore, and they have sought in the court of Queen's Bench to restrain the corporation from discharging rubbish into the sea at night, when it is difficult to insure that it is carried out to the proper limit. The refuse is said to interfere seriously with fishing in some places, as the floating material gets into the nets. It is essential that the refuse should be taken right out to sea, and this is impracticable in stormy weather, when the system breaks down, causing great inconvenience.

(To be continued.)

SCREW PILE PIER IN AFRICA.

(With inset.)

The screw-pile pier here illustrated is now being built by the French Government at Kotonou, in the Gulf of Benin, for the purpose of better landing troops and material and the crossing of a dangerous bar. The builders are Messrs. Dayde & Pille, of Creil; the contract was signed on August 23, 1891, and the work is to be finished by January 1, 1894. As can be imagined, the difficulties were great in transporting and unloading the large amount of material required on this remote and unprotected coast.

The total length of the pier will be 913 ft., and the entire framework is made of steel, excepting only the screws and the caps of the piles, which are cast iron. The floor will be 13 ft. above the highest tides. The pier itself is made up of two parts; the approach, which will be 769 ft. long and 17.28 ft. wide, and the landing, which is 144 ft. long and 43.34 ft. wide. The approach carries two railway tracks of 2.6 ft. gage.

As shown in the longitudinal elevation, two systems of pile supports are used; one extending from the shore into water about 13 ft. deep, and a double pile system running out to water 28 ft. deep. The general arrangement and the details of the framework are sufficiently well shown in the accompanying drawings, and need little special description. In the single pile system the bents were spread 26 ft. apart on their longitudinal axes; and in the sea-end each bent is made of four piles spaced 13 ft. apart longitudinally and 10 ft. apart transversely. These latter bents are spaced 39.1 ft. apart between the outer piles. The landing stage is shown in half cross section. The head of this landing and the most exposed part of the pier contains 20 piles disposed in four transverse rows 13 ft. apart.

The piles themselves are made of steel, are uniformly 5⅜ in. diameter, and they vary in length from 23 to 65 ft. All of the ties in the piers are made of round steel 2⅜ in. in diameter. The longitudinal beams have a total depth of 1.47 ft. and the transverse beams are 1.14 ft. deep. Under the cranes on the landing stage, however, the floor beams are 2.6 ft. deep. The entire floor of the approach and landing is made of heavy oak plank.

The disembarkation of the material required for this pier was one of the most difficult features of the enterprise. For this purpose the contractors

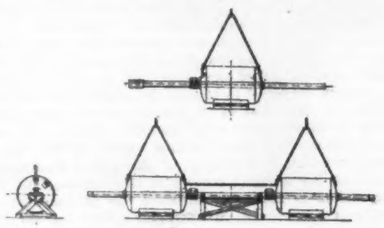


Fig. 1.

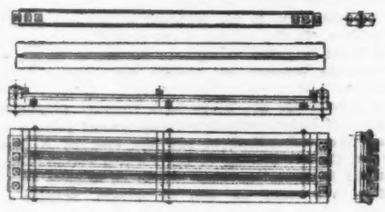
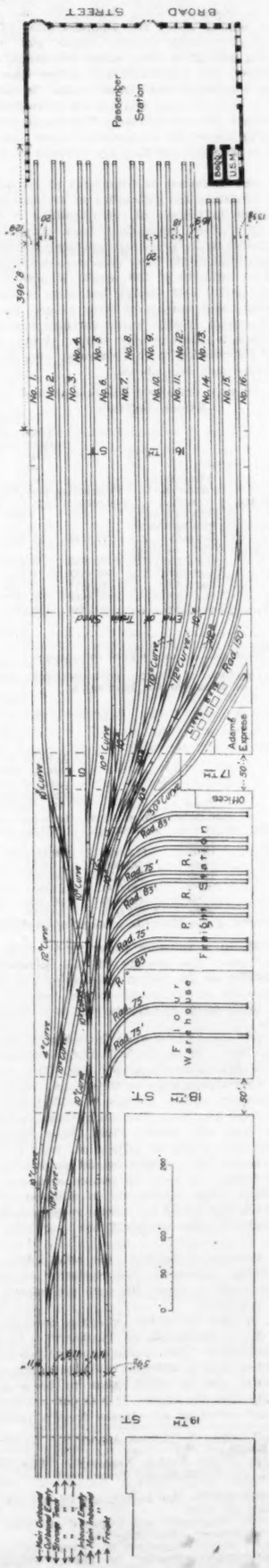


Fig. 2.

Floats Used in Landing Material for Constructing the Screw Pile Pier at Kotonou, Africa

used metallic floats of the forms shown in Figs. 1, 2. For landing the piles, the floats were cylindrical in form with domed ends and pierced longitudinally by a tube. A number of these floats were strung upon any one pile sufficient to float it, whatever might be its weight. They were put together upon the deck of the ship and lowered into the water by spars and then hauled to the beach by a cable gear, about 1,700 ft. long, extending from the ship to the shore. The floats were also provided with watertight manholes and small material was carried inside them in proper quantity. In landing the beams, two pieces of white pine were bolted to the beam at the ends, one on each side, thus floating it and thoroughly protecting it against damage by shock. Rafts made of the flooring material were also employed in transporting these beams, and in all cases they were hauled to the beach by the tackle before mentioned. The erection was accomplished by the aid of a rolling traveler, shown on the inset. This apparatus, with the general dimensions given, was somewhat narrower than the distance between the two rows of piles, so that no lateral motion was necessary and all lifting was done from the sides. The platform carries shears for lifting the piles and placing them, drums for screwing down the piles and winches for operating these drums, and under the projecting portion of the traveler is suspended a light platform for the workmen. The lifting tackle at each side of the end derrick frame had a capacity of nearly 8,000 lbs. Under each of these tackles three guide-collars were arranged at a convenient distance apart and sufficiently strong to keep the pile in its exact position during the operation or screwing down. The upper guide was hinged so as to facilitate the passage of the pile from the horizontal to a vertical position.

When the approach pier and the central portion of the landing stage had been built by means of this traveler, a modification of the same machine was used in the construction of the lateral parts of the landing. We are indebted to "Le Genie Civil" for the original matter of which the above is an abstract.



PLAN OF FINISHED AND TRACKS AT THE NEW BROAD ST. STATION OF THE PENNSYLVANIA R. R. AT PHILADELPHIA; Wm. H. Brown, Chief Engineer.

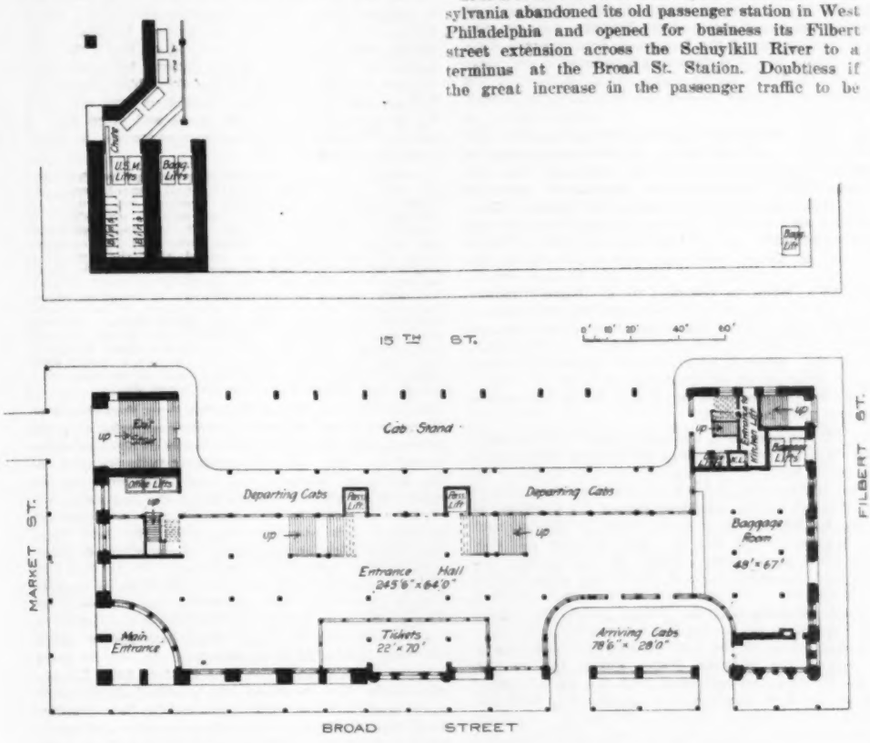
**** "Collection, Treatment, and Disposal of Town Refuse," by C. J. Lomax, 1892.

* Paper by H. Percy Boulnois, C. E., City Engineer of Liverpool, read before the Liverpool Engineering Society, April 20, 1892.

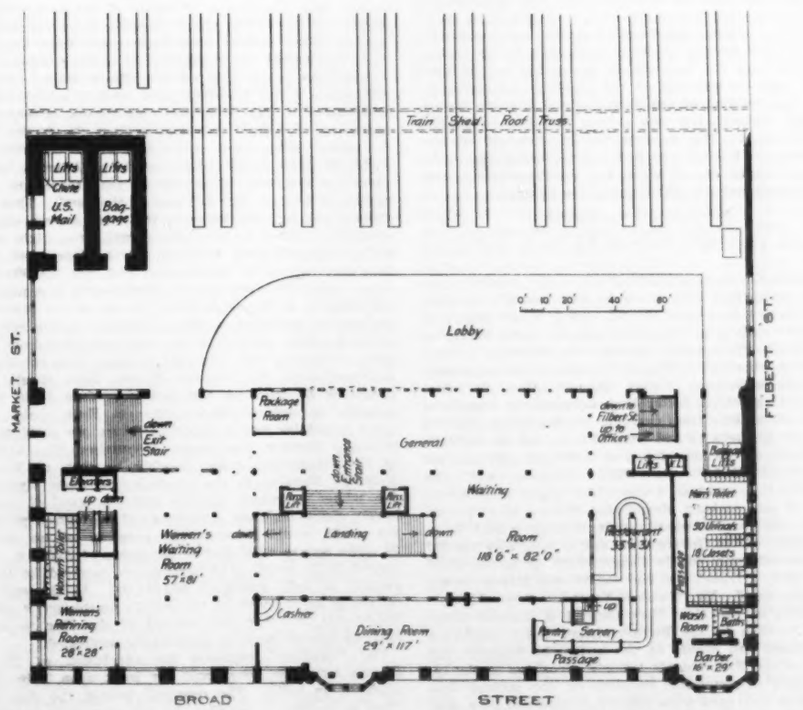
THE NEW BROAD ST. STATION OF THE PENNSYLVANIA R. R. AT PHILADELPHIA.

There is probably no passenger station in the United States owned or used by a single railway company in which such a large volume of traffic is handled as in the Broad St. Station of the Pennsylvania R. R. in Philadelphia. In every other great city of this country the traffic is divided up among several railway companies; but in Philadelphia, notwithstanding the considerable volume of traffic which enters and leaves the city via the Reading and Baltimore & Ohio lines, the great bulk of the passengers entering and leaving the city pass through the Pennsylvania station at Broad street.

It is a little less than eleven years since the Pennsylvania abandoned its old passenger station in West Philadelphia and opened for business its Filbert street extension across the Schuylkill River to a terminus at the Broad St. Station. Doubtless if the great increase in the passenger traffic to be handled at that point had then been foreseen, the station then built would have been made sufficient for the growth of at least a score of years, instead of requiring to be doubled in size at the expiration of a little over half that time. It should be said, however, that besides the natural growth of traffic, the station has been used as the terminus of lines for which no provision was made in its original plans. The report of General Manager Frank Thomson, of March, 1882, stated that at the time the plans of the Broad St. Station with its tracks and approaches were completed it was not expected that the Philadelphia, Wilmington & Baltimore and West Chester traffic would be brought into it. While the station was being built, however, the controlling interest in these lines was acquired, and soon after the station was opened the traffic of these two lines alone amounted to 43% of the total traffic in and out of the station.



FIRST FLOOR OF BROAD ST. STATION, PHILADELPHIA.



PLAN OF SECOND FLOOR OF BROAD ST. STATION, ON LEVEL OF TRAINSHED TRACKS.

The result of this unexpected addition to the traffic, combined with the natural growth of traffic on all the Pennsylvania lines centering at Broad St., has been to crowd the station to its utmost capacity. The original Broad St. Station had 8 tracks in the trainshed and four tracks immediately adjacent devoted to handling local freight. In 1890 the crowding of trains on the passenger tracks became such that the four freight tracks were utilized for passenger service and a new interlocking plant was erected to govern the twelve tracks. But this even was not sufficient to accommodate the train movement during times of heavy traffic, and of course no addition whatever was made to the accommodations for passengers.

The latest train schedule, dated Oct. 1, 1892, shows 250 trains arriving and 253 trains leaving the Broad St. Station daily, not counting either the handling of empty trains in and out of the station, or the second and third sections of trains. Between the hours of 7 and 9 a. m., 44 trains are scheduled to enter the station and 30 trains leave it.

The crowding of trains on the tracks is of course not evident to the ordinary observer; but anyone can see the vast difference between ample and scant accommodations for the passengers themselves by watching the stream of travelers in Broad St. Station and those in the new Pennsylvania station at Jersey City.

We show herewith the adopted plans for the new Broad St. Station. The old station had 8 tracks in the trainshed, covered by a roof in two spans. The new station will have 16 tracks in the trainshed. The Pennsylvania trainshed at Jersey City has but 12 tracks. The relative dimensions of the old trainshed, the new trainshed, and the Jersey City trainshed are as follows:

	Old Broad St. trainshed.	New Broad St. trainshed.	Jersey City trainshed.
No. of tracks.	8	16	12
Width.....	170 ft.	306 ft. 9⅝ ins.	256 ft.
Length....	396 ft. 8 ins.	647 ft.	652 ft. 6 ins.

The new trainshed will cover the whole width of the block between Market and Filbert Sts., and the passenger station will cover the whole frontage on Broad street. The arrangement of accommodations in the new station is clearly shown by our drawings.

The erection of the new station and trainshed would at first sight appear to be a considerably more difficult matter than at Jersey City, as all the work must be done so as to interfere as little as possible with the handling of the present heavy traffic, which will doubtless be largely increased during the coming year. At Jersey City the passenger trains were handled on temporary tracks in the present freight yard while the station was being erected.

But remembering that the new roof at Broad St. will be built over and outside of the present roof the best plan for erection is clear. The track on the Filbert street side of the present station will be abandoned to make room for placing the foundations of the new roof trusses. A traveler similar to that used at Jersey City (Eng. News, Dec. 27, 1890), will be erected on top of the present trainshed roof and will run on tracks built along it. The new roof will first be completed and the old roof will then be removed. Handling the crowds of passengers while the new station is being erected to replace the old one will be more difficult; but by careful contriving and planning it can be done. A marked contrast between the new and the old stations will be in their height. When the old Broad St. Station was erected there was hardly such a thing as a modern high office building in Philadelphia and the station was made 4 stories in height. The new station will be 14 stories high, the upper stories being used for offices.

Considerable progress has already been made on

the work of construction and it is expected to have the additional tracks completed and available for handling the World's Fair traffic.

We must not fail to note that the span of this new roof will far exceed the span of the Philadelphia & Reading's new trainshed at Twelfth and Market Sts., which is 259 ft., exceeding by a few feet the span of the Pennsylvania's trainshed at Jersey City. This had at the time of its completion the greatest roof truss span covering a railway trainshed in the world. But this distinction reverted to the Reading on the completion of the Market St. terminal. The Pennsylvania now intends to regain it, and will probably keep it for some time unless some one purchases the Manufactures Building for a trainshed at the close of the Columbian Exposition.

PERSONALS.

Mr. Wm. Bauer, County Surveyor, died at Houston, Tex., Sept. 30.

Mr. Charles F. Potter, U. S. Division Engineer of Missouri River Improvements, died at Omaha, Neb., Sept. 28.

Mr. Isaac A. Smith, M. Am. Soc. C. E., of St. Louis, Mo., is preparing plans and specifications for a system of water-works at Centralia, Ill.

Capt. Albert A. Nelson, a government surveyor of eastern Texas, died at Nacogdoches, Tex., Sept. 24. He was born at Milford, Mass., in 1814.

Mr. S. M. Allis, of Malden, Mass., has resigned his position as Superintendent of Water-Works, at Malden, Mass., and has accepted a position at Chicago, with the Kinsman Block Signal Co.

Mr. E. P. Hannaford, Chief Engineer of the Grand Trunk Ry., has resigned, and has been succeeded by Mr. Joseph Hobson, Chief Engineer of the Western Division and of the St. Clair tunnel.

Mr. W. Scott West, sanitary engineer and architect, of New York, N. Y., died in Washington, D. C., Sept. 18. He was the inventor of the West system of sewerage, which is in operation at Atlantic City, N. J.

Mr. M. Hector, C. E., has been elected engineer to the Rodney Irrigation & Water Supply Trust, at Tatura, Victoria, Australia, vice Mr. Walter Scott Murray, deceased. Mr. Hector has had considerable experience in carrying out works under the Irrigation Act.

Mr. W. S. Hamilton, of Youngstown, O., has resigned his position of superintendent of the city water works and will probably take a position with the Ohio Steel Co., of Youngstown, in connection with the construction of the company's new steel plant. It is stated that Mr. Hamilton has been connected with the city water works since it was built in 1872.

Mr. Thomas Struthers ,of Warren, Pa., died Sept. 29, at the age of 89. He was one of the first directors of the Philadelphia & Erie R. R., built the Oil Creek & Allegheny River R. R., with but one associate; built a street car line in Cincinnati, and undertook the improvement of the Des Moines River for steam navigation. He also founded iron works in Corry and Struthers, O.

Mr. Charles Guidet, a prominent granite contractor, of New York, N. Y., died in this city recently. He was born at Cologne, Germany, in 1831, came to this country in 1855, where he has been engaged in the business of granite block paving. He was the inventor of the Guidet pavement, consisting of granite blocks laid on a concrete foundation, the blocks being laid with close end joints and open side joints.

Mr. Charles W. Buchholz, M. Am. Soc. C. E., Chief Engineer of the New York, Lake Erie & Western R. R., has been appointed President and Chief Engineer of the Quaker City Elevated R. R., of Philadelphia, Pa. He has been Chief Engineer of the Erie R. R. since 1884, and has carried out many improvements in the way of double tracking the line to Buffalo, laying heavy rails and establishing a block signal system.

Mr. Frederick O. Norton, F. Am. Soc. C. E., died at his New York home on Sept. 27, aged 54 years. Mr. Norton was born in Eastport, Me., in 1838. He early identified himself with the development of Rosendale hydraulic cement, and by improved processes and care in manipulations, he was instrumental in very much improving the qualities of these native cements. At the time of his death Mr. Norton was president of the F. O. Norton Cement Co., one of the largest producers of cement in the United States.

Mr. Edgar Marburg, lately bridge engineer with the Carnegie Steel Company, Limited, has been appointed acting professor in charge of the department of civil engineering at the University of Pennsylvania. Prof. Marburg is a graduate of the Rensselaer Polytechnic Institute, and for seven years has been connected in the capacity of designing engineer, with the Keystone Bridge Co., the Edge Moor Bridge Works, and the Phoenix Bridge Co.

Mr. J. P. O'Donnell, signal engineer, of London, England, is visiting this country and investigating the railway systems, with a view to introducing here the various devices and signal and interlocking plant in which he is interested. He reports a very good reception from a number of the leading railway companies. Mr. O'Donnell designed the extensive new switch and signal plant at the Waterloo terminal station, in London, of the London & Southwestern Railway, which was described and illustrated in our issue of June 23, 1892. He was also signal engineer of the underground electric line of the City & South London Ry. Co.

Mr. Oliver H. Dorrance died in Chicago recently. He was born at Amherst, Mass., in 1838, and became a telegraph operator. He became connected with the Kansas Pacific R. R., and was subsequently promoted to be superintendent of the Smoky Hill Division, leaving that road in 1876 to accept the position of Master of Transportation on the International & Great Northern Ry., in Texas, under the late H. M. Hoxie. He remained on different lines under Mr. Hoxie's control until 1881, when he returned to the Kansas Pacific R. R., as Superintendent of the Smoky Hill and Denver Divisions. In 1884 he was transferred to Omaha and given charge of the Nebraska Division of the Union Pacific Ry., resigning this position in 1887, to accept that of Manager of the Union Stock Yards Co. Early in 1887 he was prostrated by a long illness, from which he never fully recovered.

Mr. M. Denman Ross, the oldest member of the Holyoke Water Power Co., died at Jamaica Plain, Boston, Mass., Sept. 14. He was born in Ohio in 1819. He studied engineering, and ran the boundary lines of several Western towns, and later turned his attention to cotton machinery. In 1846 he went to Boston, and Mr. Lawrence made him the first agent of the Bay State mills, at Lawrence, Mass. In this capacity he supervised the construction of the factory at Lawrence and the setting up of the plant therein. He continued in charge of these mills for several years. He took a deep interest in developing the water power and business enterprises of the city of Holyoke, and was a director of the Holyoke Water Power Co. for 23 years. He was also associated with Mr. Levi L. Willcutt in the New England Felt Roofing Co., was the founder of the Boston Thread & Twine Co., president of the Mercantile Wharf Corporation, a director of the Quincy Market Cold Storage Co., and also of the Boston Safe Deposit & Trust Co. The idea of an institute of technology and an art museum for Boston originated with Mr. Ross, and it was mainly through his influence and exertions that legislation was accomplished and the needed means obtained to secure their establishment. He was also largely instrumental in removing the Boston Society of Natural History to its present location near the Institute of Technology on the Back Bay, and he was one of the building committee for the new building of the New England Historic Genealogical Society. He was among the first to suggest and advocate the construction of elevated electric railways in Boston, and had many schemes for public improvements, one of which was for the establishment of a ship canal and water power for Chicago.

NEW PUBLICATIONS.

OCTOBER MAGAZINES.—Politics is naturally the topic occupying most space in this month's reviews, and cholera is a good second. The "North American Review" prints a symposium on the latter topic, or rather on "Safeguards Against the Cholera." There is not much novel in it except, perhaps, the suggestion of Surgeon-General Walter Wyman, that an international agreement be made prohibiting the vessels of Christian nations from carrying Mohammedan pilgrims in their journeys to and from Mecca. All the authorities unite on the importance of both local and national quarantine.—Under the title, "Politics and the Weather," a satirical writer pictures the possible results of rain making, should that feat be made practically possible. Necessarily, rain making would be in the hands of the Government, and a man who wanted rain would apply to his Congressman or to the local boss, or to a friend who had contributed largely to the campaign fund. Mr. Theodore Voorhees, General Superintendent of the New York Central & Hudson River R. R., writes on the Buffalo strike. After reviewing the causes and events of the strike, he explains the cause of the Switchmen's Union's opposition to the introduction of automatic couplers on the ground that they fear that yard work will be so safe and easy that any man can be trained to take their places at short notice. He explains well the reasons why railways are always able to obtain efficient employees at small wages. There is a fascination in railway service which irresistibly attracts a large number of young men. Once in its power, but few leave the service. A man who has followed a railway career for a number of years is practically unfitted for any other life. In conclusion, Mr. Voorhees urges with force that some form of insurance or superannuation fund for employees ought to be provided as part of the regular organization of all corporations.

The "Forum's" paper on cholera is by Dr. Lewis A. Sayre, formerly Resident Physician of New York, and is entitled "The Lesson of Preceding Epidemics," which lesson is, in brief, that quarantine, faithfully and rigidly enforced, is a sure method of preventing the spread of the disease. Bishop Potter's temperate plea for the Sunday opening of the Columbian Exposition will probably attract most attention of any article in the number, coming at this time, and from such a source. The following paragraph expresses well the spirit of the article:

> Let the Columbian Exposition proclaim by the hush of all its varied traffic and machinery,—no wheel turning, no engine moving, no booth or counter open to buyer or seller, no sign or sound of business through all its long avenues, and better still, by its doors closed till the morning hours of every Sunday are ended—that the American people believe in a day of rest. But if there be those who would later seek its precincts to look, it may be, more closely at the handiwork of man, to study the progress of the race in the story of its artistic and industrial and mechanical achievements, and to recognize thus, it may easily be, in the study of such achievements, with Job, that "there is a spirit in man," and that "the inspiration of the Almighty giveth him understanding"—that, certainly, can be no unworthy use of some hours of our America's rest day.

In the "Popular Science Monthly," an English writer discusses the use of mud as building material, or, more correctly, the use of sun dried bricks in place of those burned in a kiln. He tells chiefly of their use in Asia, the cradle of the race; and might add much to the value of his article by describing the extensive use of this material in the tropical and semi-tropical regions of both American continents. Mr. John Coleman Adams gives an interesting account of the development of the science of meteorology. While Franklin has the credit of being the first American to suggest a faint idea of the laws governing the movement of storms, the name of Wm. C. Redfield is that which is most prominent in this line. Commodore Maury called him "the Kepler of storm physics." It will be news to many of this generation that the late Elias Loomis was among those to whom the practical development of the science in this country was chiefly due. Another paper describes a novel system of warming and ventilating a dwelling, consisting in building hollow walls and heating the space between them instead of the house itself. The scheme is the invention of M. Somesco, a French civil engineer.

The "Californian Illustrated Magazine" has a paper by Mr. Wm. M. Pierson, President of the Astronomical Society of the Pacific Coast, showing the preposterous nature of the various suggestions made from time to time concerning the feasibility of making signals to suppositious inhabitants on the planet Mars. In the first place, unless scientists have made a mistake, the atmosphere of Mars is so rare that 5½ ins. of mercury represents it normal pressure, against the 30 ins. of the earth's atmosphere. Life, such as we conceive it, could not exist under these conditions. Assume, however, for the sake of argument, that there are inhabitants there similar to those on the earth. Then, if signals are to pass between the two, a day signal should be replied to by a day signal, or a night signal by a night signal. This can only be done when the two planets are at quadrature, and are 120,000,000 miles apart. The atmosphere of the earth is a practical obstacle to day signaling. We do obtain fugitive glimpses of markings on Mars, miscalled canals, which are at least 60 miles in width, and many hundreds of miles in length, and it is only because they are lines and long ones, that we can discern them at all. A square of 60 miles on the earth's surface could not possibly be seen at Mars' distance. Even could we move mountains into geometrical forms, we could gain nothing. Neither the Rocky Mountains, the Andes or the Himalayas, could possibly be seen at Mars' distance. Turning to the possibility of night signals, the writer estimates that to make a point of light barely visible on Mars, a telescope of the highest power yet made would demand the covering of an area 10 miles square with electric arc lights of 20,000 c. p., spaced 10 ft. apart. The horse-power required for this amount of light would be 669,081,600. As the entire estimated horse-power of the world's machinery is only 394,000,000, we fear this method of signaling to our Martian friends must be temporarily postponed.

The "Century" contains the conclusion of Mrs. Foote's irrigation novel, and her work upon it is the work of an artist. The reservoir behind the dam is filled as rapidly as possible, by the manager's orders, to make a celebration at the opening of the work. The chief engineer's advice that at least a month be taken to fill the basin is not heeded. The pent-up water finds an exit at the weak spot beneath the stone dam, where a pile foundation had been put in, and the flood goes roaring down the valley, carrying destruction with it. It is easy to be wise after the event, and the manager commands that in repairing the break

the excavation shall go down to rock at whatever cost. The paper in this number which will attract most attention, however, is that on "Money in Practical Politics," by Jeremiah W. Jenks. It is a paper which deserves careful study by every man who has the least spark of honest devotion to the welfare of his country and the perpetuity of its institutions.

In this month's "Scribner's" is a paper on "Launching Cruisers and Battle Ships," by Wm. J. Baxter, U. S. N., a subject with which few engineers outside of those engaged in shipbuilding are familiar. It is interesting to note that the pressure of the sliding ways upon the ground ways is from 2.5 to 3.5 tons per sq. ft. The inclination of the ways varies from 1 in 12 for small vessels to 1 in 20 for very large ones, 1 in 16 being the most common. The ways are lubricated with a mixture of tallow, soft soap, and fish oil. Mr. H. C. Bunner gives a pleasant account of the progress of work at the Columbian Exposition, criticising a few features and praising many, and humorously likening himself to a boy who peered through a hole in the circus tent and gives to his companions a fragmentary and hurried account of the dazzling show in process of preparation.

POOR'S DIRECTORY OF RAILWAY OFFICIALS and Manual of American Street Railways.—New York: 1892; H. V. & H. W. Poor; cloth; 8vo; pp. 590.

In addition to the usual lists of railway officials, foreign railways, street and private railways, the present issue of the directory contains a directory of railway directors. Some of the departments, especially that of street railways, have been considerably enlarged, and the book otherwise improved.

MASTER CAR BUILDERS' ASSOCIATION.—Report of the Proceedings of the 26th Annual Convention. Jno. W. Cloud, Secretary, Chicago, Ill. 8vo., paper, pp. 315; 17 plates.

The proceedings of this convention were given at length in our issues of June 16 and 23. The official report comes out with commendable promptness, considering that it contains the list of subjects and committees for the next convention, and the results of the letter ballot, which have only just been announced.

TRADE PUBLICATIONS.

TIE PLATES.—Q & C Co., New York and Chicago. 12 mo., pp. 8.

This little pamphlet sets forth the advantages of the Servis steel tie plates for the general improvement of railway track.

SOCIETY PROCEEDINGS.

VICTORIAN INSTITUTE OF SURVEYORS.—At the August meeting at the offices of the Institute, in Melbourne, Victoria, Australia, a motion was carried, favoring an amalgamation with the Victorian Institute of Engineers. Professor Kernot read a paper on "The Testing of Materials and the Details of Construction," and Mr. J. T. N. Anderson read a paper on "Water Valves and Their Gearing."

ROADMASTERS' ASSOCIATION OF AMERICA.—The dates upon which the coming convention will be held have been changed to Nov. 15, 16 and 17, on account of the large number of members of the Association who are employed on roads centering in Chicago, and who, owing to the immense traffic over their lines before and after the Columbian Exposition opening ceremonies cannot leave their posts of duty.

J. H. K. Burgwin, Secretary.

AMERICAN INTERNATIONAL ASSOCIATION OF SUPERINTENDENTS OF BRIDGES AND BUILDINGS.—The annual convention will be held at the Palace Hotel, Cincinnati, Oct. 18. The following are the subjects for discussion: Surface cattle guards; Frame and pile trestles complete, including re-railing appliances; Framing and protection of Howe truss and other wooden bridges against fire and decay; Iron and vitrified pipe for waterways under railway embankments; Water tanks complete, including painting, pumps, pump and coal houses, wells, and reservoirs; Interlocking plant and signals; Depot platforms complete; Paint for iron structures.

CENTRAL RAILWAY CLUB.—At the meeting on Sept. 28, a report was received from the special committee appointed to confer with the Superintendents' Association, concerning the delivery of bad order cars, which are not unsafe to run, and are consigned to local points. While the committee was nominally continued, it was generally understood that it had accomplished all it could. It was voted to notify the Superintendents' Association that the opinion of the club was as follows: Cars for local delivery, bearing M. C. B. defect card should be accepted if not unsafe to run to their destination, provided they bear an additional card directing their return to their owner when empty. At the next meeting, Nov. 23, the subject for discussion will be: "What May Be Considered 'Home Defects' On Freight Cars—Defects Which May Be Passed to Owners by Inspectors?"

AMERICAN STREET RAILWAY ASSOCIATION.—The annual convention will be held at Association Hall, Cleveland, O., Oct. 19, 20 and 21. Special committees will report on the following subjects: "A Model Electric Street Railway Roadbed and Underground Wiring;" "A Perfect Overhead Electric Construction;" "Economy of Machine Shops for Electric Street Railways;" "Power House Engines;" "Relative Cost of Operation of Horse, Cable and Electric Roads," and "Standards for Electric Street Railways." Notice has been received by the Secretary that special papers will be read, under the following titles: "Experiments on the Expension of Continuous Rails," and "Is a Standard Rail Head Possible?"

Ample accommodation has been secured for exhibitors of street railway supplies. Mr. H. J. Davies, Secretary of the Brooklyn Street R. R. Co., of Cleveland, will have charge of the exhibits. Reduced rates on the certificate plan have been granted, and instructions for obtaining them may be secured by application to the Secretary, Mr. Wm. J. Richardson, cor. Atlantic and Third Aves., Brooklyn, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting held on Sept. 21, the paper on "The Strength and Weathering Qualities of Roofing Slates," by Mr. Mansfield Merriman, was read by the author. A brief discussion followed by Mr. C. B. Brush. He referred to the old test of balancing a slate on the hand and proving it with a sharp blow, the quality being indicated by the clearness of the sound resulting. The behavior under punching was also an index. He complimented the author on his avoidance of a monotonous reading of the whole paper, and the presentation, in a conversational and attractive manner, of the points made. The same remark might have been made as to each of the other papers which were presented by the authors in person. Mr. Merriman said that brittleness was clearly indicated by the character of the rupture under the bending test proposed in the paper; he could give no information on the ringing.

The second paper was on "Tests of Power Taken to Drive Electric Street Cars," by Mr. Louis B. Bonnett. Mr. Brush, in discussion, mentioned the importance of determining the loss of power in transmission from the station to the car. In the use of the trolley system, a company with which he was connected used at first a return circuit of copper wire, and they found a loss of power in the transmission of about 10%. The return wire was stolen, and they then grounded the ends of the remaining wire, when the loss on a length of 1¼ miles was reduced to less than 1%.

Mr. Charles E. Emery thought the paper valuable, and one showing much care in its preparation. It was not applicable to motors now used, which were much more powerful and developed higher efficiency. Mr. Alfred F. Sears thought that the larger motors show little evidence of greater efficiency.

The third paper was by Mr. Alfred F. Sears, on "Motive Power for Street Railways." Written discussions were presented by Mr. E. N. Kirk Talcott and Mr. H. W. Brinckerhoff. The former favored the direct application of steam to motors, and prophesied its success. Mr. Brinckerhoff presented a report of the Birmingham Central Tramways Co., of Birmingham, England, which uses, on different lines in the same city, locomotives, horses, cables and electricity. The figures, both as to cost per mile run, including all fixed charges, and also revenue per mile run, favor the cable system. Mr. Dodge, the inventor of the Chicago steam street car, described his system. It is a simple locomotive receiving a charge of steam and water at 400° F. With this and the consumption of 37 lbs. of anthracite coal, it will travel 20 miles, carrying a load of passengers, the pressure during this run being reduced from 165 to 135 lbs. Mr. Emery commented on this, that such a motor for long steep grades becomes a locomotive and has all its disadvantage of weight. The heaviest grade yet overcome by electric motors was one of 14%, at Richmond, Va., by double reduction motors. At Reading, Pa., cars weighing 22,000 lbs. with motors of 35 h. p. make a speed of 9½ miles per hour on a 3.6% grade.

Remarks were also made by Messrs. W. H. Breithaupt and R. L. Harris. Mr. Jarvis presented briefly the claims of a compressed-air motor.

At the meeting on Oct. 5, a paper was read on "Combination Bridge Building on the Pacific Coast," by Alfred D. Ottewell. By the term "combination" the author means bridges in which wood and iron, or wood and steel, are used; those members in compression being chiefly of wood, and those in tension of metal. Howe trusses, suspension and arch bridges are barred out. The system of webbing used is generally the Warren, Pratt or the Petit form, the Pratt up to spans of 200 ft., and the Petit for greater spans, the webbing system being superior in the latter. The amount of inclination given to the top chord is a vexed question. For spans up to 300 ft. parallel chords between end hip connections are preferable. The reason for building such bridges on the Western coast is the abundance of excellent timber, and the high charges for freight on iron, etc. As an example of the system, the cantilever bridge across the North Umpqua River in Oregon was described and illustrated. The shore arms are 147 ft. each, the river arms 105 ft. each, and the suspended span is 80 ft. The method of erection was also discussed. An estimate of the saving by using these bridges was made by supposing one 22-ft. panel of a top chord to be subject to a strain of 300,000 lbs.; the saving on this panel of the chord is estimated at $113.80 by using the combination rather than a steel panel. Another example briefly described was the bridge across the Salinas River in California. The second paper of the evening was on "Some Notes on Foundation Experiences," by A. P. Boller, an abstract of which was printed in our issue of July 28.

The following letter to the Secretary has been received from Prof. E. A. Fuertes, who was a regularly appointed delegate to the Congress on International Navigation held at Paris. Mr. Fuertes mentions but one of the papers read. Valuable papers were read also by other delegates from the society:

Sir: As delegate to the International Congress on Internal Navigation, held in Paris, I have the honor to report that "the Society" was honored by my election, as such delegate, to the office of First Vice-President of the "Economic Section," this being an honor to which no personal merit of mine could have aspired. Also, I have to report that the General Secretary, M. de Mas, Chief Engineer des Ponts et Chaussees, at my request, promised to send, for the library of the Society, a complete set of all the publications of the Congress. The meetings were of marked value and interest, and one of the best papers read, and containing thoughtful and well-digested matter, was presented by our colleague, Mr. North. The poor condition of my health has prevented an earlier report, and makes impossible now a more extended account of the interesting sessions of the Congress, which was managed with great skill, not only in its administrative details, but also under technical and social points of view.

Very respectfully,
E. A. Fuertes.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF MINNEAPOLIS.
Oct. 6. Secy., F. W. Cappelen, 1628 Hennepin Ave.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Oct. 6. Secy., C. H. McLeod, Montreal, P. Q.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Oct. 6, Special meeting. Nov. 14 to 18, Annual meeting. Secy., F. R. Hutton, 12 West 31st St., New York.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Oct. 7. Secy., E. K. Smoot, 803 Commerce St.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Oct. 7. Secy., O. Von Geldern, 719 Market St., San Francisco.

WISCONSIN POLYTECHNIC SOCIETY.
Oct. 9. Secy., M. G. Schinke, City Hall.

ENGINEERS' CLUB OF KANSAS CITY.
Oct. 9. Secy., Waterman Stone, Baird Building.

AMERICAN SOCIETY OF RAILROAD SUPERINTENDENTS.
Oct. 10, Hotel Brunswick, N. Y. City. Secy. C. A. Hammond, Boston.

NORTHWESTERN SOCIETY OF ENGINEERS.
Oct. 11. Secy., F. H. Warner, Seattle, Wash.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
Oct. 11, Secy., Chas. S. Howe, Case School.

DENVER SOCIETY OF ENGINEERS AND ARCHITECTS
Oct. 11. Secy., Geo. H. Angell, 36 Jacobson Block.

ATLANTA SOCIETY OF CIVIL ENGINEERS.
Oct. 11. Secy., Parker N. Black, Capitol Block.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Oct. 11, 12, 13. Reading Pa. Secy., R. W. Raymond, N. Y.

CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Oct. 12. Wichita, Kan.

ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Oct. 13. Secy., Edward Mead, Norton Building.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Oct. 13. Secy., R. N. Clark, Pittsburg, Pa.

WESTERN RAILWAY CLUB.
Oct. 18, Rookery Building, Chicago. Secy., W. H. Marshall.

ENGINEERING ASSOCIATION OF THE SOUTH.
Oct. 13. Secy., O. H. Landreth, Nashville, Tenn.

NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Oct. 14. Secy., D. W. Meeker, St. Paul.

MONTANA SOCIETY OF CIVIL ENGINEERS.
Oct. 15. Secy., F. D. Jones, Helena.

ENGINEERS' CLUB OF PHILADELPHIA.
Oct. 15. 1122 Girard St. Secy., L. F. Rondinella.

AMERICAN ASSOCIATION OF SUPERINTENDENTS OF RAILWAY BRIDGES AND BUILDINGS.
Oct. 18. Annual convention. Palace Hotel, Cincinnati, O.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Oct. 19. Secy., S. E. Tinkham, City Hall.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Oct. 19. Secy., F. Collingwood, 127 East 23d St., New York.

ENGINEERS' CLUB OF ST. LOUIS.
Oct. 19. Secy., Arthur Thacher, Odd Fellows' Building.

AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 19, 20, 21. Cleveland, O. Secy., Wm. J. Richardson, Brooklyn, N. Y.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Oct. 20. Secy., C. F. Franson, 113 Adams St.

NEW YORK RAILROAD CLUB.
Oct. 20. Secy., H. G. Prout, 73 Broadway, N. Y.

ENGINEERS' CLUB OF CINCINNATI.
Oct. 20. Secy., J. F. Wilson, 24 W. 4th St.

TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Oct. 21. 201 Washington Building.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
Oct. 21, 22, Roanoke, Va. Secy., J. R. Schick, Roanoke.

WESTERN SOCIETY OF ENGINEERS.
Nov. 2. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.

SWEDISH ENGINEERS' CLUB.
Nov. 5. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia.

NORTHWEST RAILROAD CLUB.
Nov. 5. Union Station, St. Paul.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Nov. 7. Secy., C. L. Annan, City Engrs' office.

NEW ENGLAND RAILROAD CLUB.
Nov. 14. Secy., F. M. Curtis, C. C. E. R., Boston.

ROADMASTERS' ASSOCIATION OF AMERICA.
Nov. 15, 16, 17. Chattanooga, Tenn., and Atlanta, Ga. Secy., J. H. K. Burgwin, Grand Rapids, Mich.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 17. At Atlanta, Ga. Secy., F. A. Charpiot, Macon.

CENTRAL RAILWAY CLUB.
Nov. 23. Secy., S. W. Spear, E. Buffalo, N. Y., Iron Works.

ENGINEERING NEWS
AND
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CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

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ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

It is reported that the Health Board of Jersey City ordered the grossly impure Passaic River water cut off from the city schools a few days ago and directed the pupils to carry tea, coffee, milk or boiled water to school for drinking purposes. This action is in line with the sanitary measures taken in several other cities, and reviewed at some length in our issue of Sept. 29, under the title, "Cholera as a Sanitary Agent." It would be difficult to imagine a more effective method of teaching the people of a city that impure water carries disease than to send thousands of children to their homes with the warning that the city water supply was so dangerous to health that the pupils must carry a substitute with them to school each day. As was stated last week, a move is being made for a new water supply for Jersey City.

A few other instances of recent efforts to improve the sanitary condition of towns may be mentioned:

At Brockport, N. Y., a popular meeting was held Sept. 23, and resolutions adopted declaring, in effect, that the water company was furnishing impure water, asking the village trustees to refuse to pay the last quarterly bill for hydrant rental, and appointing a committee to procure a warrant for the arrest of a member of the water company. Whether this action was warranted we cannot state.

The town officials of Westchester, N. Y., recently made a personal inspection of the town to ascertain what steps should be taken to prevent the introduction of cholera.

The Haverhill (Mass.) "Gazette" aptly though ungrammatically states that: "A filthy city with a foul water supply is ready for the entrance of a patient with a bacilli."

It will be a great pity if the managers of the World's Columbian Exposition adhere to their present determination not to allow the use of photographic cameras on the exposition grounds. In view of the present extensive use of photography it would be equally as sensible to prohibit the use of note and sketch books on the grounds. Thousands of those who visit the Exposition will visit it as students, and one will doubtless see pencils and notebooks in extensive use. To forbid visitors the use of the best means of collecting and recording information would be a most unfortunate step, for it is the Fair's value as an educational factor which alone justifies the enormous outlay which is being made upon it.

Possibly the inciting cause of this order was the idea that the setting up of tripod cameras, here, there and everywhere, by numerous amateur photographers might interfere with the free movement of the crowds; but if there were reason to apprehend this, regulations might easily be enforced limiting the use of tripod cameras to certain specified times. Cameras of the "detective" type are too familiar nowadays for their use to attract any attention, so they certainly could not be objected to on this score.

We know of no other reason for prohibiting the use of cameras on the grounds except the desire to gain additional revenue by the manufacture and sale of "official photographs," very few of which will be of value to the man who spends his time at the Fair in making an exhaustive study of some special subject. But if it is absolutely necessary that something should be realized from the sale of photographic privileges, it would be wiser to charge a license fee for the use of cameras on the grounds. The exacting of such a tax from those to whom the display at Chicago will be an exposition and not a show would be deplorable; but it would be far preferable to absolutely preventing their use of the best available facilities for the study of exhibits.

In our issue of Aug. 11 last we published an article on "Car Sill Repairs and General Averages," showing how closely the arbitrarily determined allowances for piece-work time on the 26 possible combinations of car sill renewals, as adopted at the last M. C. B. Convention, corresponded to a simple general law.* The correspondence was so close as almost to forbid the supposition that each allowance was independently fixed from actual averages of each particular case, except that the fractional variations were so arbitrarily distributed while yet generally small, and so much larger with refrigerator cars than with the "other" cars, which includes all but a small fraction of the cars in use, as to indicate that each must have been separately determined. We have had the curiosity to inquire, however, and learn that this last was in fact the case. Mr. F. D. Casanave, Supt. M. P. of the Pennsylvania Co., on which line the schedule originated, replies as to this point, as follows:

Sir: Replying to your inquiry, I may say that price-list of car repairs was made from actual records of time consumed in repairing each part. Since reading your article on the subject I have looked into the matter and find that in the renewal of sills and stringers there is a certain nearly constant amount of work to be done, such as the removal and replacement of end sills, truss rods, etc., which is the constant found in all kinds of car sill renewals, as the prices for the removal and replacement of such parts are permanently fixed, as in the case of all other items of work. Since looking into the matter of differences you call attention to, I find that some errors were made in reporting the prices to me in some items that show the greatest deviation from the rule you have applied. These, however, do not amount to very much, and we will endeavor to correct them at the next meeting of the Master Car Builders' Association. This price-list was, before presentation to the Association, considered by the Arbitration Committee, of which I was Chairman. In going over our figures some of the members of the committee suggested some slight changes, which I consented to make, because I recognized the fact that only shops familiar with piece work could compete in doing this work at the prices which we proposed to establish.

I can, therefore, say that the basis of all our piece work prices is that of actual records of the cost of doing the work by an average workman, the operations being repeated as often as necessary, and by different men, in order to arrive at an equitable price.

The very large plans which are being made for World's Congresses in connection with the Columbian Exposition appear to be in need of extensive pruning to bring them into anything like manageable shape. As near as we can learn, the intention is to hold congresses on about every possible topic and to discuss exhaustively in each all conceivable questions in connection with the subject. It must be easily seen that to attempt such a scheme in connection with the World's Fair is to attempt the impossible. It is true that the Fair will attract men of eminence in every line of work from all over the world who will wish to meet each other, and it will doubtless be possible to obtain some valuable papers for presentation—by title—in the World's Congresses. But to expect much more than this seems unwarranted. That an audience, even of savants, would prefer to listen to the reading of exhaustive dissertations rather than spend the time studying the countless wonders of the Exposition seems highly improbable. Nor will the detailed discussion of abstract questions attract many of the active and intelligent minds which give a discussion its value.

As an example of what is planned for these congresses, we commend to our readers' notice the list of questions published in another column which are proposed for consideration by the "Railway Commerce Congress." It will be seen that the questions proposed for discussion are very similar to those discussed in the annual conventions of state railway commissioners. In these conventions three days' work are found sufficient to get through, we should judge, something like a twentieth or a fiftieth of the work which is mapped out in the list of questions proposed for this congress. Surely it would be better for such a congress to confine itself to a very few topics, choosing those of greatest importance, than to attempt thus to cover the earth. Granting even that able papers can be secured upon all the topics proposed in this list, few even of those directly interested will spend the time for their study and discussion when other demands on time and strength are so great.

There is another danger, moreover, in the holding of these congresses, supposing them to attract the men who are really interested in the questions proposed. It is that the discussion would degenerate into a heated statement of opposing views, already pretty well known to the public. Suppose for instance in the proposed railway congress the railway commissioners of some of the Western states were to be pitted against Mr. M. M. Kirkman on the question "Governmental Regulations of Transportation and Practical Results Thereof." The controversy would doubtless be highly exciting, but it would hardly be especially useful as a means of enlightenment.

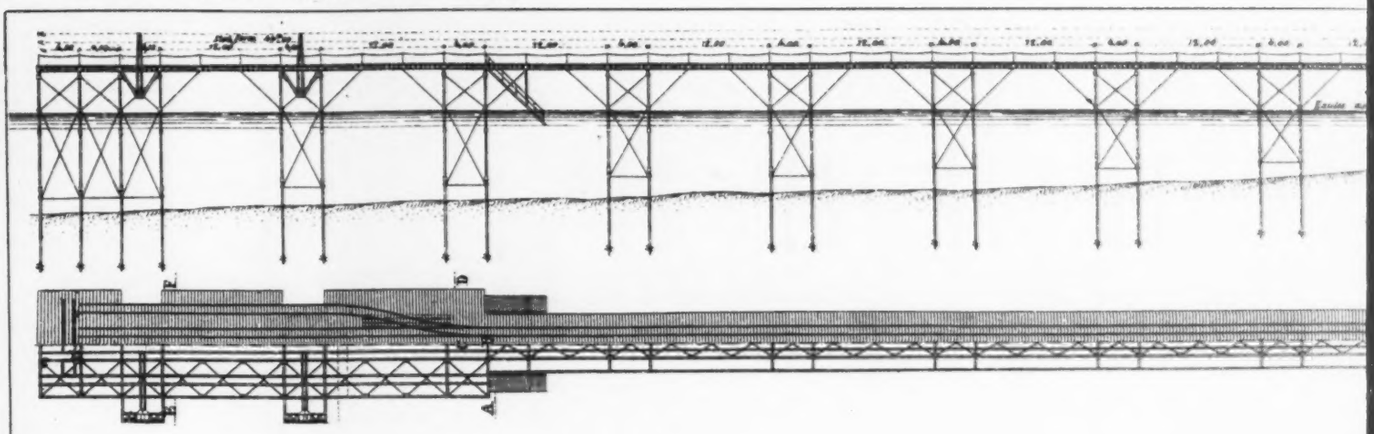
The question of all those proposed which would probably cause the greatest interest, however, is "Railway Receiverships; the Practical Lessons They Teach." Certainly the man who devised these questions was either lacking a sense of humor or overflowing with it. One can imagine a portly Briton or gesticulating German rising when this question was called to answer with profound emphasis that railway receiverships had taught him the practical lesson to put not his trust in princes,—of the class which manipulate American railways in Wall Street. There is not the slightest doubt that a great many visitors to the fair, from both this and other countries, would be delighted to discuss this question at Chicago, if possible, with Mr. Jay Gould himself. Should a full and free discussion on this question be had, with the proper persons present to take part in it, we should doubtless have to withdraw our criticism above that the World's Congresses were not likely to attract a crowd. An "experience meeting" in which British lords and German barons and confiding investors of every land should unite in relating their practical lessons from railway receiverships would be a highly unique and entertaining spectacle.

The late marvelous performance of Nancy Hanks on a regulation circular track, so far outdoing both her own and all other records, seems to indicate that, after all, it was the pneumatic tire and ball bearing rather than the kite-shaped track which enabled her to make her great record of 2:07¼, the best previous records having been 2:08¼ by Sunol and 2:08¾ by Maud S. This conclusion is strengthened by the fact that the very next day the pacer Mascot made identical time with Nancy Hanks, also on a regulation track, thus outdoing all previous pacing records. At Indianapolis, Sept. 28, the latter mare made a mile in 2:04, the last quarter being made in 29½ seconds, or at a 1:58 pace, the last half mile being made at a 2:02½ pace; thus breaking the record for the third time this season, her successive records being 2:07¼ Aug. 17, 2:05¼ Aug. 31, and 2:04 Sept. 28. The pacer Mascot's record of Sept. 29 differed from this last only in the fact that the quarter mile at a 1:58 rate was the third instead of the last quarter. The best previous pacing record was 2:05¼, we believe; certainly it was considerably higher than the trotting record.

Besides these two great events, several minor

*This general law, we may repeat, was for refrigerator cars, 16 hours for each side sill, 12 hours for each intermediate sill and 18 hours for each center sill, plus a fixed allowance of 30 hours in each case, regardless of the number of sills replaced, whether 1 or 6.

For other cars the rule was, 14 hours for each side sill, 5 hours for each intermediate and 16 hours for each center sill, plus a fixed allowance of 25 hours in each case, regardless of the number of sills.



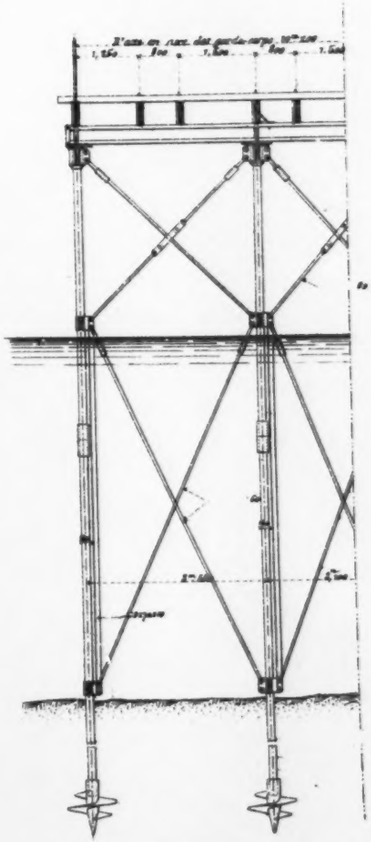


Fig. 3. Half Transverse Section.

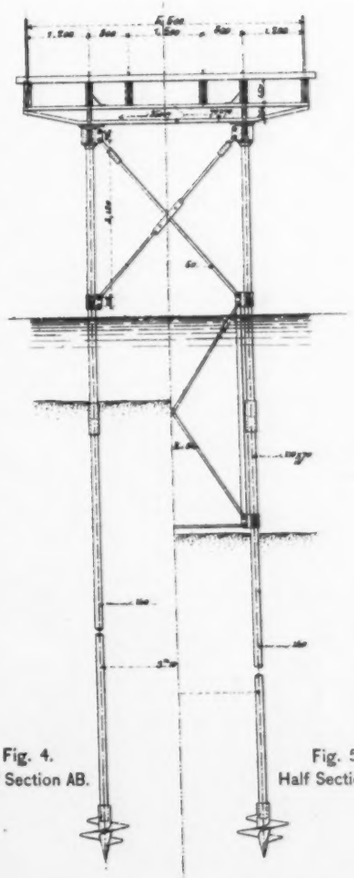


Fig. 4.
Half Section AB.

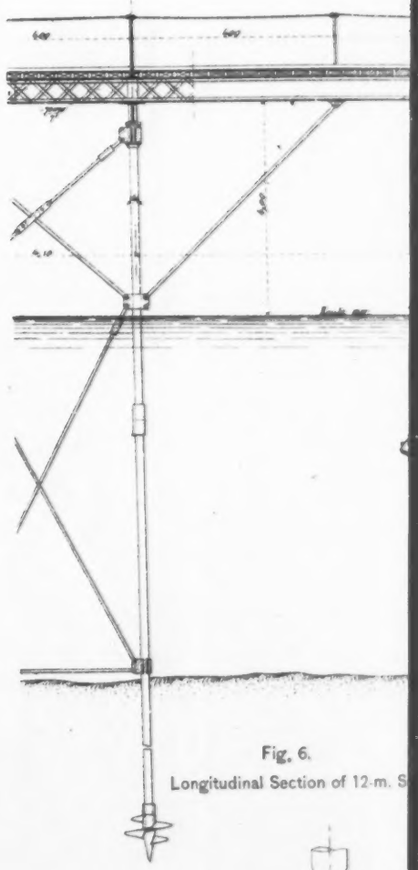


Fig. 5.
Half Section CD.

Fig. 6.
Longitudinal Section of 12-m. S

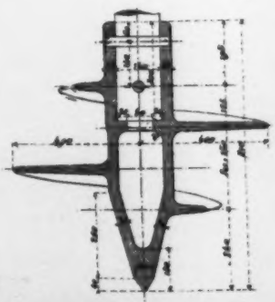


Fig. 12. Section.

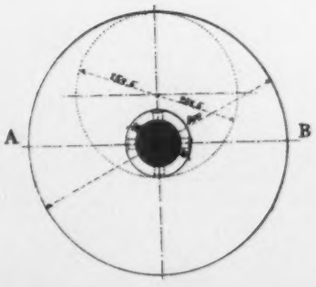


Fig. 13. Plan.

DETAILS OF SCREWS.

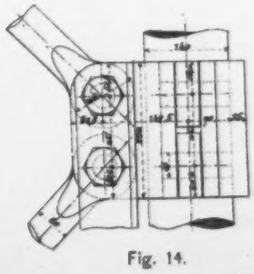


Fig. 14.

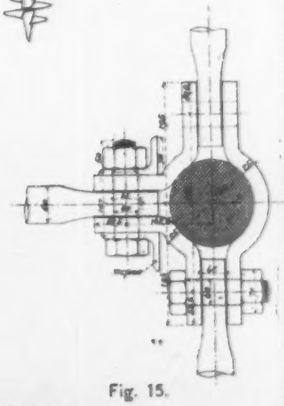


Fig. 15.

INTERMEDIATE COLLARS.

SCREW-PILE PIER

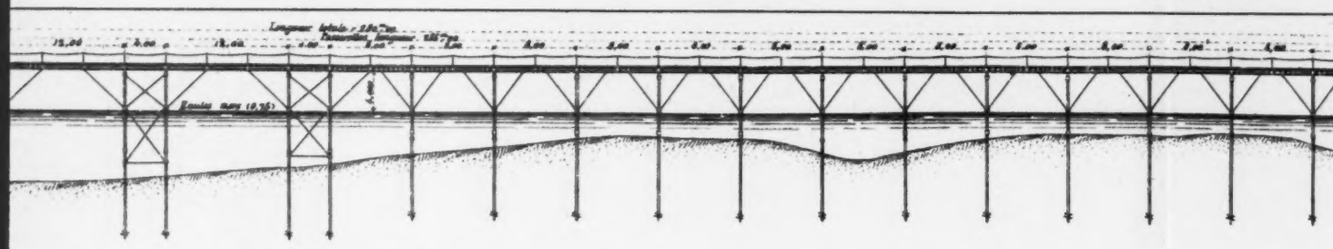


Fig. 1. General Elevation.

Fig. 2. Plan.

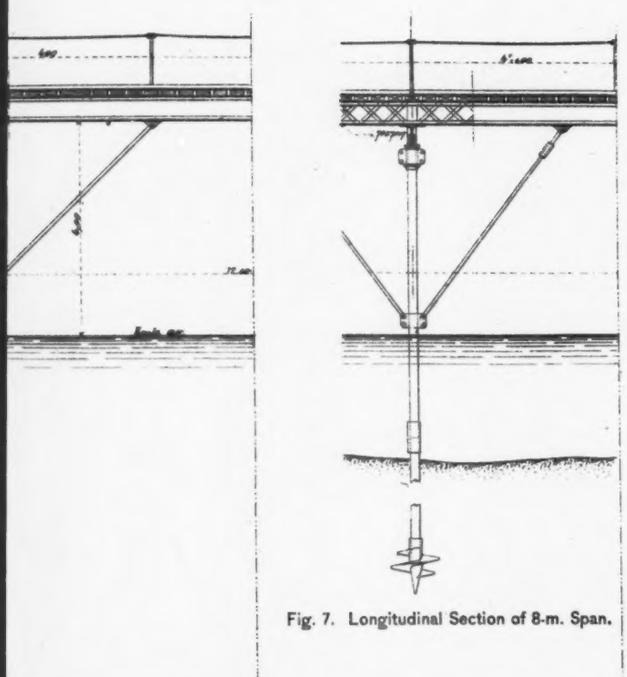


Fig. 6.
gitudinal Section of 12-m. Span.

Fig. 7. Longitudinal Section of 8-m. Span.

Fig. 8. Section ab.

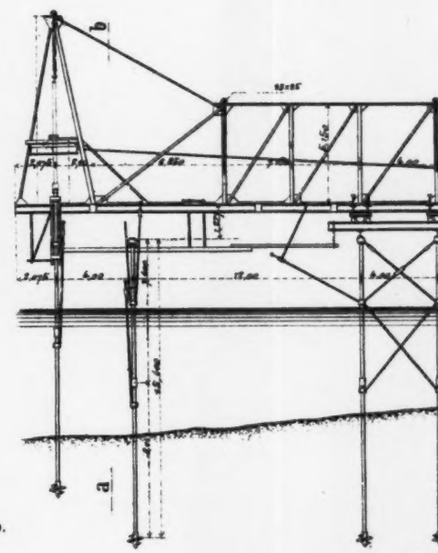


Fig. 9. Elev

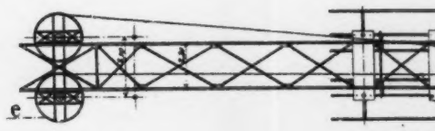


Fig. 11.
TRAVELER USED IN

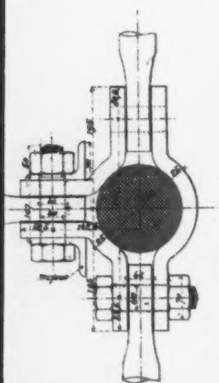


Fig. 15.

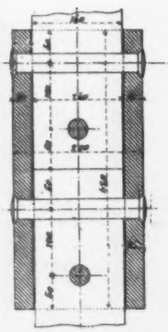


Fig. 16.

Fig. 17.
COUPLING SLEEVE.

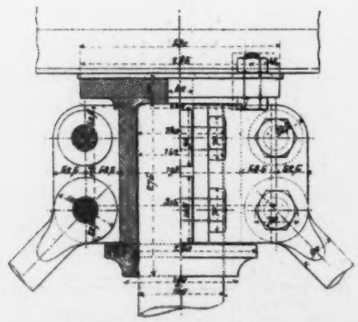


Fig. 18. Elevation and Longitudinal Section.

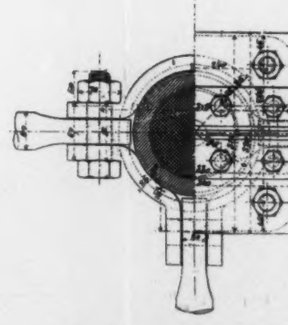


Fig. 19. Plan and Horizontal
CAPS AND UPPER COLLARS.

REW-PILE PIER AT KOTONOU, GULF OF BENIN, AFRICA.

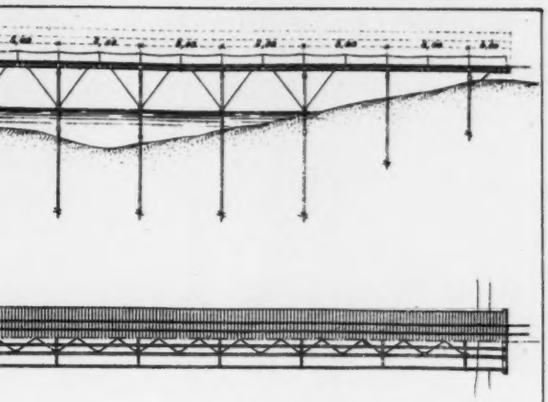
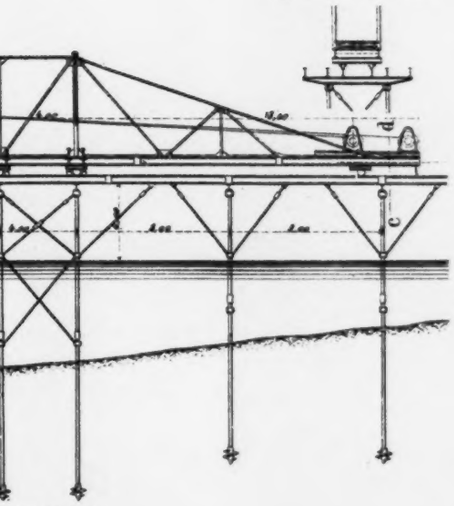


Fig. 10. Section cd.



g. 9. Elevation.

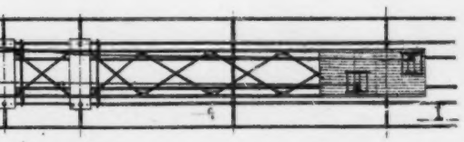
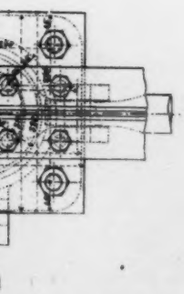


Fig. 11. Plan. .

USED IN PLACING PILES.



Horizontal Section.

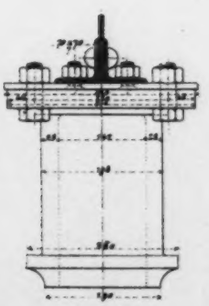


Fig. 20. Elevation of Cap.

CHAS. HART & SONS, LITH, 84 VESEY ST., N. Y.

records of various kinds have been much outdone within the last few weeks on regulation tracks. These facts strongly indicate that the kite-shaped track has really much less effect than was supposed to lower some recent records made on it, the real cause being either the pneumatic sulky or improvement in the animals themselves. The last may yet prove to be the case. It is a pity that a fair and careful test cannot be made. But in any case the multiplication of kite-shaped tracks is likely to be seriously checked by recent events. It casts a cloud upon all records made upon it without sensibly aiding to improve them, if recent events may be trusted.

CITY REFUSE DISPOSAL.

Dr. Pettenkoffer, of Munich, who has made a special study of cholera for 30 years and is an acknowledged authority, says that the spreading of the epidemic is entirely dependent on the sanitary conditions of the locality where it shows itself. The contagion is conveyed only from organism to organism through food or drink and foul smells. This same authority severely criticises the decrees of the German Government, and denies that isolation or quarantine measures have any value whatever. He says that in a city exposed to cholera infection by reason of its trade with infected or foreign ports, the best preventives are good drinking water, a complete system of sewerage and perfect sanitary arrangements even in the lowest quarters.

This is a sensible statement, and no intelligent man will be inclined to disagree with him; but until these conditions do exist, every precaution is both wise and necessary. One of the good results of our own experience with pest-ships in the harbor of New York is a lively awakening to the fact that our sanitary conditions are not altogether up to the standard prescribed by Dr. Pettenkoffer, especially in the matter of housing our poor and in disposing of street and house refuse. Experiments made in Naples show that the street sweepings there are 1,319 times richer in living bacteria than ordinary liquid sewage; and in Munich, where Dr. Pettenkoffer resides, the living bacteria found in one gramme of street sweepings ranged from 8,000 to nearly 13,000,000. These experiments show that this material is peculiarly favorable for cultivating the micro-organisms and rain upon it facilitates this growth. The volume of street and house refuse, separate from human waste, is enormous in a large city, and the returns from six English cities, including London, Liverpool and Leeds, show an average volume of about 180 tons per 1,000 inhabitants per annum. The treatment of this 300,000 to 400,000 tons of refuse in New York is a serious problem, involving enormous annual expenditure. But the present disposal practice is crude and unsafe, and something better should be done.

A recent proposition to dispose of about 10,000,000 cu. yds. of New York refuse by filling in about 400 acres of Long Island Sound, east of and adjacent to Riker's Island, might be temporarily a relief, as far as transportation is concerned. But from a sanitary standpoint such disposal is certainly open to serious objections. The cost of burning refuse in properly designed furnaces ranges from 12 cts. to 54 cts. per ton, according to statistics gathered by Mr. Boulnois, the City Engineer of Liverpool. And in a destructor lately erected by him for Liverpool, the cost is 30 cts., exclusive of interest on the plant; and each furnace, of from 8 to 10 tons capacity, cost about $4,000. For the city of Edinburgh, Prof. George Forbes proposes the use of the ash-bin refuse as a fuel for generating electric light. But as the refuse consumption must go on continuously and the light is only needed at night, he proposes to use the fuel for pumping water into a storage reservoir and then converting this stored water into hydraulic power, through turbines, to run the dynamos. Prof. Forbes estimates that for this service 10 lbs. of ordinary ash-bin refuse is equal in fuel value to one pound of common coal. This plan requires favorable local conditions for its successful operation and the still more difficult condition of a more perfect system than we have for separating and collecting garbage, street cleanings and house refuse.

Other great cities find refuse disposal quite as serious a problem as does New York. Berlin removes its street sweepings to a safe distance beyond the city limits and takes especial care to prevent it from contaminating water courses. London treats its sewage chemically, but until lately, at least, permitting the sorting of its street and house refuse, a practice which is properly condemned as leading to the possible introduction of foul and infected matter into the slums of a city where it is liable to do most harm. Liverpool, in 1891, sent 145,032 tons of refuse to sea in dump-barges at a cost of 37 cts. per ton, including the loading. But as in New York complaint is made that this system breaks down in stormy weather and the matter is dumped at points from which it is washed up again onto the shores. A garbage collecting company in St. Paul, Minn., is now entering into a contract with the city authorities to collect garbage, on alternate days, in tight hardwood barrels, and to utilize this material in converting a sandy district of 10,000 or 12,000 acres, at some distance from the city, into a market garden district; with what success remains to be seen, for previous attempts of this kind have been very unsuccessful commercially.

In a word, the refuse of a city like New York is very great in volume and includes such a vast variety of rubbish in its composition that the problem of disposing of it is a most serious one in its dimensions. Dumping into the sea at points remote enough from land not to interfere with navigable channels, or to be cast back upon the shores, would be doubtless the best immediate solution. But experience proves that it does not work at all seasons, and the supply of refuse is constant and growing. To burn it requires an enormous outlay for plant and maintenance, and care that the operating is not a nuisance to surrounding habitations. To attempt to separate it according to its fuel value is almost impracticable; and to permit culling by contract for rags, iron, tin, etc., is to invite disease into quarters already too dangerous and difficult to watch. But when we consider that the sanitary wellbeing of two millions of people may depend upon the manner in which this refuse is disposed of, it is seen that some intelligent solution of this complex problem must be reached, and our city authorities can not afford to allow matters to relapse into old ruts as soon as the present cholera agitation is over. It is no case for cheese-paring or economy, and when it is once realized that a large sum of money must be spent for this public life insurance it is certain that men can be found to point out the means.

ENGLISH AND AMERICAN SHIPPING.

Our contemporary, the "Engineer," in commenting on the present activity in the United States in the shipping and shipbuilding interests, discusses at some length, and with rather unusual fairness, the probable importance of the recent awakening of the shipbuilding interests on this side of the water to English industries of the same class. The "Engineer" shows, what we all know, that for nearly 100 years the United States was a successful rival of England in shipbuilding; but after using to the fullest extent the statistics of the decline of the American industry since 1860, it leaves for another issue the consideration of whether or not the American people are likely to recover any considerable part of this lost trade.

The figures given by the "Engineer" of the relative carrying trade of England and America in the period 1855-1890, form in themselves a suggestive text for American readers. According to these figures, in 1860 the American marine carried 65.7% of all foreign products coming to our shores; in 1890 this trade had fallen to 21.8%. English ships, on the contrary, in 1860 carried to and from the ports of the United Kingdom, 59.3% of all entries and 58.3% of all clearances; and in 1890 these percentages had risen to 73.1 and 73.2. As far as percentage of total home trade goes this is not such a marked increase on the American record for 1860; but the tonnage represented in the traffic between England and America has enormously increased, and in a manner that seriously affects general results from an American standpoint. In 1860 the United States sent to England products of the value of $165,000,000, or 19.4% of total imports to that country; but in 1890 these figures had changed to $425,000,000, or 22.5% of the total imports into England. As an offset to this the value of English exports to this country had in the period named only increased from $95,000,000 to $140,000,000 per year. But, says the "Engineer," the value of the business of carrying this big traffic could hardly be less than $75,000,000 to $100,000,000 per year; and this carrying trade is done mainly in the hulls of ships neither built nor owned by Americans.

This is a lamentable showing and it will take hard work, as our contemporary says, to catch up again. But what has been done can usually be done again: especially by the people of the United States. For example, in 1884, the first vessel of our new navy was launched, and the Secretary of the Navy estimated that in 1894 we should possibly have a fleet of 70 ships, aggregating 316,000 tons and carrying 540 heavy guns. When we commenced building modern war ships, about eight years ago, we had few shipyards, no past experience in that class of shipbuilding, and literally no plant for making armor or heavy guns. But in 1893 all but one of the contemplated fleet will be afloat, built in American yards and with American material and armed with guns, equal to the best, made also at home. The first of the 13-in. heavy guns that "we could never make," a few years ago, is now being finished in the works of the Washington Navy Yard, and there has just been completed in this same yard a plant capable of producing a 16-in. gun, which will be the largest in the world.

It may be truly said that it is one thing to build a new navy, with a vast national surplus to draw upon, and quite another thing to create a merchant marine that will compete with our neighbors across the sea, but that must be built and maintained out of private capital. And our English contemporary also remarks that the higher rates of wages for seamen and officers on this side of the water will make it "obviously difficult" for Americans to get a footing in the business.

But we were there "with both feet," in 1860, when the nominal steam tonnage of the American merchant marine was 870,000 tons, as compared with 502,000 tons for all England. And between 1841 and 1860 our average annual increase in tons carrying power was 259,000 as compared with 180,000 for the United Kingdom. With an output of iron now exceeding that of England, with unsurpassed machine tools, with experienced mechanics and the work accomplished in the creation of a new war fleet, the question of higher wages disappears, and our shipbuilders even now offer to reproduce any of the great Atlantic liners at their English cost and less. The wages paid to the men working the ships can be adjusted as in the days before 1860, when the officers and crews of our clipper ships received the highest wages of any merchant marine afloat; and yet by the speed and excellent handling of these ships they more than held their own in the face of all competition.

The "Engineer," in its editorial, tells what the clipper-ship of 1845 was, and especially refers to the "Sovereign of the Sea," a sailing ship of 2,421 tons, with a length of 258 ft., a beam of 44½ ft. and a depth of 28½ ft. from keel to deck plank. For four days, in a voyage from Honolulu to New York, this ship averaged 398 miles, and on one day sailed 436 miles, which is a good "steamer record" even now. These ships were designed and built by Americans to meet an emergency in competing trade; and while the conditions have changed our country has also advanced enormously in resources and experience, and there is no good reason why the same inventive talent should not suggest a way of outstripping modern competitors, once the full energy of our engineers and mechanics is turned that way. We shall wait with considerable interest to see what view the "Engineer" takes of this question. This controlling fact, however, will long give England an advantage. This country has a continental interior which is still but partially developed. England has only a small interior which has long been very thoroughly developed. Its whole energies are therefore directed to extending its shipping and foreign trade. Ours are not and cannot be for a long time to come. Therefore, when the day comes that we are more than a good second to her on the seas it will indicate that in all other respects we have left her far behind. But even if we do thus outstrip as we probably shall, she will still be a great country, with a grand and glorious past, and never, we may be sure, with a paltry or ignominious present or future. We shall still owe to her most of what is good in our civilization. Let us hope that the rivalry, such as it is, may grow more and more generous and friendly.

Steam brakes are to be applied to about 20 broad-gage (5 ft. 6 ins.), freight engines of the Bombay, Baroda & Central India Ry.

Electric illuminations and decorations of an extensive character were carried out at Washington, D. C., by the General Electric Co., on the occasion of the recent meeting of the Grand Army of the Republic. Running from near the Pennsylvania R. R. station to the Treasury, pole lines were erected on both sides of the avenue. At short intervals along these two lines different corps badges were designed in small, but brilliant incandescent lamps. Above each badge the name of some notable fight in which the corps took conspicuous part, or well-remembered sojourning place during the war, was written in electric lamps. At rarer intervals, the portraits in oil of the leading war generals were suspended, each surrounded by a double border, the inner one of very small lamps; the outer of lamps of larger and higher candle power. The decorative set pieces included an anchor 20 ft. long, and twin stars of red and blue. At two points was erected a monster fac-simile of the G. A. R. badge, 18 ft. high, made up of incandescent lamps, white and colored. The illumination of the Treasury Building was effected by arranging along the cornice at the top of the fluted columns a line of colored arc lamps, and similar lights were also used to illuminate the camp. On the White House lawn, the bushes, trees, ferns and flower beds glistened with the light of innumerable miniature lamps, and ten revolving stars, each of different design, were also set up here, and constantly changing in design and color. On the roof of the Washington Loan & Trust Building were set four 24-in. General Electric Co.'s projectors, three facing the Capitol and one facing the monument. During the evening the light from these projectors shot the national colors on the clouds, or illuminated the surroundings of the city. The best effects were obtained, however, when the whole four were brought to bear on the Capitol or on the Monument. All this display was not obtained without great effort. Less than 30 days elapsed between the commencement of the work and the illumination. Poles had to be erected, and a whole three-wire system installed, drawing current from every available dynamo, public or private, in the city. In fact, not enough current could be procured. Some idea of the work can be gained from the fact that over 25,000 incandescent lamps were used in the illumination, as well as over 100 arc lamps.

The docks at Southampton, England, are of interest at present in view of the decision of the Inman Line to run its steamers between New York and Southampton, instead of Liverpool, and the Red Star Line to make Southampton a port of call for the steamers between New York and Antwerp. The London "Times" says that nature has given the port the exceptional advantage of a double tide, for, in addition to the usual high water there is a second high water, occurring about two hours after the first. The situation of the Isle of Wight across the mouth of Southampton Water causes a portion of the great tidal wave in its progress up the Channel to be separated from the main volume. Flowing up the Needles passage into the Solent, this detached body reaches Southampton, producing the first tide. At the ebb, this tide is arrested and forced to return by the main stream coming from Spithead. Thus the second tide is experienced, and this is usually six or eight inches higher than the first, while low water is not reached until three and one-half hours after the second flood tide. Consequently, the water in the harbor is, for all practical purposes, stationary for a period of two hours, and in this way ample opportunities are allowed for ships to enter or leave the docks. The present estate of the Southampton Dock Co. covers over 200 acres, and embraces a tidal dock 18 acres in extent, with a minimum depth of 26 ft. at low water of spring tides, and an entrance from the Solent 175 ft. wide. Round this dock are quays measuring altogether 3,750 lin. ft. There is also a tidal basin, covering 16 acres, with an entrance 150 ft. wide, a depth of about 31 ft. at high water spring tides, and 27 ft. at high water neap tides. Immediately adjoining is a close dock of 10 acres, with a depth over the sill of 29 ft. at high water spring tides, and of 25 ft. at high water neap tides. The total amount of quay space provided at these two water areas is about 7,500 ft., so that altogether there is already 11,250 lin. ft. available. There are four dry docks, varying in length from 250 ft. to 450 ft., and in width from 51 ft. to 80 ft., while the water space over the blocks ranges from 15 ft. to 25 ft. The docks are intersected by a complete system of railways, 15 miles long, directly connected with the main line of the London & Southwestern Ry., at the Harbor station, so that passenger and freight trains can pass direct to the various railway systems of the country. The London & Southwestern Ry. Co. has recently let a contract for the construction of a large graving dock, especially for the use of the Inman Line steamers.

LETTERS TO THE EDITOR.

SHEET-PILING ON ROCK.

Sir: Engineering News of Sept. 15 contains an article upon an alleged new method of sheet-piling on rock, practiced on the C. & E. I. R. R., at Momence, Ill. I beg to say that I have personally used this method for the past 8 years, and to my certain knowledge it was practiced 20 years before that. We were particularly successful with it in the construction of foundations of the B. & O. bridge, over the Schuylkill River, at West Falls, Pa., where the coffers were sunk to solid rock in 19 ft. of water. For Mr. Baldwin's further information, if he will first cut the bottom of the plank to a knife edge, drive them hard, so as to blunt the edge, then releasing them, and with an axe chop out the blunted parts, and finally drive them home again, he will have a much tighter dam than one planked by his method.

Yours truly,
O. M. Weand,
Engr. and contractor.

Reading, Pa., Sept. 28, 1892.

SUBMARINE SENTRY AND SOUNDING MACHINE.

Sir: I have to thank you for your notice and illustration of my submarine sentry and sounding machine in your issue of Sept. 8.

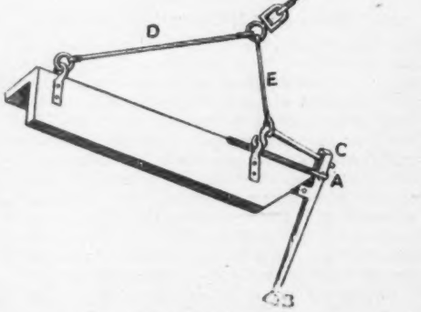
Personally I have to thank the press generally, not only in England, Russia, Holland, Germany, France, Spain, Turkey, China, and New Zealand, but also in the new world of America for many unsolicited notices. The invention was designed not to save when in danger, but to go beyond that and save the ship from getting into a position where life could be in danger.

The "St. James Gazette" and the "Times" both sent their own representatives to sea to test it practically, neither myself nor any one representing me being present, and these two papers took it up on public grounds alone. I believe it was the first time that the old-fashioned "Times" ever illustrated anything.

Yours faithfully,
S. H. JAMES.

London, England, Sept. 21, 1892.

(From the article in the London "Times" we abstract the following detailed description of the device, as well as the accompanying view of the same. The sentry consists of two pieces of board, screwed



The James "Submarine Sentry."

together at right angles, and pointed at one end. An inch or two from the square end, on the ridge formed by the meeting boards, is a ring. A strong spring ending in a hook occupies a groove cut into the ridge at the pointed end. Over the spring, but not connected with it, rises a ring attached to the wooden sides by iron ribs, and in the ring is twined another ring, which is the end of an iron pin long enough to project about half an inch beyond the pointed end of the wood. When the sentry is in action the outside of the angle formed by the boards is uppermost. At the pointed end is the striker, an iron rod working upon a hinge fixed at the pointed end of the wood, having at the top a hole capable of receiving the point of the pin before mentioned, and at the bottom a hollow capable of receiving tallow or other adhesive substance calculated to bring up a sample of the ground when it has been reached. To prepare the sentry for action it is necessary to affix it to the extremity of the wire on the winch by two wires. Fine piano wire of the best quality, not twisted but single, is used. Of these the first is fastened to the ring near the square end; then the hook at the end of the spring is placed round the striker; then the second of the two wires, which has a ring on its end, is threaded upon the pin, and a little force applied to the striker makes it easy to thrust the pin through the hole at the top of the striker. The device has been tried successfully both as a safety and sounding device on a number of war ships and ocean steamers.—Ed.)

CHEAP RAILWAY CONSTRUCTION.

Sir: Referring to the query of Mr. C. W. S. Wilson, in the Sept. 5, number of Engineering News, as to the average difference in cost per mile in the construction of a standard and narrow gage railway, the following statement might prove of interest: It represents the entire cost of 14 miles of narrow gage (3 ft.) railway, except the rails, angle bars, bolts and spikes, and 1.4 miles of tracklaying.

The railway in question was the Pittsburg, Castle Shannon & Washington R. R. Later on the name was changed to the Pittsburg Southern R. R., and it was extended from Castle Shannon, Pa., to Wright's Farm, Pa., some two miles beyond Finleyville, all points in the vicinity of Pittsburg, Castle Shannon being the terminus of the Pittsburg & Castle Shannon R. R.

Quantities.		Items.	Rate.	We omit the (cents.—Ed.) Amount.	Totals.
65,482	Cu. yds.	Earth excavation	.16¼	$10,641	
5,030	"	Loose rock excavation	.26½	1,333	
3,973	"	Solid rock excavation	.44½	1,768	
2,798	"	Foundation excavation	.12	336	$14,078
				346	346
222,763	Ft. B.M.	Trestles	25 00	5,569	
1,443	"	Ties on trestles,	.10	144	5,713
450	"	Water tank, etc	....	11	11
15,130	"	Culverts	....	304	
.....		Labor on culverts	....	421	
.....		Drain pipe culverts	....	35	760
34,634	"	Bridges	....	539	
.....		Labor on bridges	....	276	815
4,535	"	Road crossings	....	71	71
.....	"	Cattle passes	....	40	40
32,833	"	Cross ties	.30	9,850	9,850
12.6	Miles	Tracklaying	....	2,336	2,336
.....		Setting frogs and switches	....	26	26
		Totals		$34,046	$34,046

You will note that the grading of the 14 miles only cost $14,078, or at the extremely low rate of $1,000 per mile. Some few miles ran as low as $500.

The railway in question was afterward extended to Washington, Pa. An independent outlet was also built from Castle Shannon to Banksville, where connection was made with the Saw Mill Run R. R., thus gaining a separate entrance into Pittsburg, Pa. (Temperanceville.) These extensions, however, were not built quite so cheaply as the original 14 miles. The railway was subsequently bought by the Baltimore & Ohio R. R., and that part between Finleyville and Washington was for a long time operated as part of their Pittsburg division. Since then some changes have been made in the alinement and grades between the points mentioned.

Yours truly, Emile Low.

Dunlow, W. Va., Sept. 21, 1892.

(This instance compares very favorably with Mr. Arthur Pew's "Cheapest Railroad in the World" (Trans. Am. Soc. C. E., 1890, p. 111), which cost $1,008 per mile for all construction except rails, or $1,164 per mile with engineering and right of way included, the distance being 11½ miles, and the gage of standard width. Such examples only strengthen the conclusion we stated, that railways may be made to cost either much or little according to standard of construction or the skill of the designer, or both. The gage in itself has very little to do with it even theoretically, and practically nothing.—Ed.)

NOTES AND QUERIES.

A correspondent asks us to inform him where he "can learn something about landscape engineering; the names of any good books on the subject and the names of the best firms in that line, and any other information that may occur to you (us)."

There are a number of books on landscape work of varying merit, which are to be found in our own and other catalogues of technical works; but from the nature of the case the landscape artist cannot be made from books. The most eminent practitioners in that line are Messrs. Fred. Law Olmsted, of Boston, and Calvert Vaux, the creators of Central Park, but there are many others now practicing; some of considerable eminence and ability. A paper on this subject by Mr. John L. Culley, will be found in the 1889 volume of the "Journal of the Association of Engineering Societies."

THE ENGINEERING SCHOOLS OF THE UNITED STATES.

XXIV.

Distribution of the Work of Instruction.

The information gathered on this head was on a list of 68 different studies, supposed to include all those likely to occupy any considerable part of a college course, which for purposes of classification we have subdivided as follows:

Class A. Elementary Mathematics. Algebra, Geometry, Trigonometry and Analytical Geometry. All of these (with the possible exception of the last) the student should have studied before entering on a professional course proper, so that his college work was merely confined to practice in them. The tendency at all the better colleges is to require them for admission, though few of them have yet reached the point where they do so.

Class B. Higher Mathematics. Descriptive Geometry, Calculus, Least Squares, Theoretical and Applied Mechanics.

Class C. Physics, Non-electric and electric. The last should even now constitute a class by itself, and in the blank which we sent out it was subdivided under four different heads. But all engineering courses throughout the country are in such a transitional and expanding condition in regard to electricity that nothing could be judged from this subdivision, or even from the totals for electricity, as there is hardly a college which will not devote more time to electricity this year, especially in its mechanical courses, than it did two years ago, when most of our information was gathered.

Class D. Modern Languages and English. French or German, English Literature, Composition, etc., Constitutional History, Mental Science, Ethics, Logic, etc., Political Economy. This class, which is the only "general culture" class, is a small one and occupies very little time in most of the courses, nearly all of which is devoted to French or German or both. The University of Pennsylvania is one of the most notable exceptions, its course being quite strong in the "humanities."

Class E. Natural Science. Chemistry (theoretical and analytical separately), Geology, Mineralogy, Metallurgy, Zoology, Paleontology, Anatomy and Physiology. The last four of these studies are little studied, as is very proper.

Class F. Surveying; with which also astronomy is included, as it is mostly studied with a view to geodetic work.

The above include the general or preparatory studies. The following classes include the strictly professional studies:

Class G. Civil Engineering Specialties. Hydraulics and Water Supply, Water Motors, Pumps and Pumping Machinery, Sewerage and Drainage, Heating and Ventilating (perhaps as properly to be included in the next class), Railway Construction, Railway Management, Bridges, Other Framed Structures, Masonry Structures and Foundations.

Class H. Mechanical Engineering Specialties. Thermodynamics, Steam Engines and Accessories. Boilers and Furnaces, Transmission of Power, Measurements of Power, Tests of Power, Friction and Oil Tests, Mill Work, Shopwork at Bench. (Machine Design, an important and separate study, should have been included in the blank but was not, and the time given to it is included elsewhere).

Class I. Mining Specialties. Assaying and Blowpiping, Mining and Tunneling, Management and Operation of Mines, Ore Dressing, Blast Furnaces, Smelting, etc., Mining Law.

Class K. General Professional Studies. Drawing not included elsewhere, Properties and Tests of Engineering Materials, Specifications and Contracts, Special Professional Reports, Business Law, Thesis.

Not all of these studies, by any means, are taught at any one college, and at all colleges the instruction on many of these subjects is so mixed up with that of others that exact subdivision is impossible, even if attempted, and many of the colleges did not attempt it. By the subdivision of the studies into classes, however, the relative number of hours given to the studies of each class collectively will, as a rule, be obtained.

In order to reduce the labor of tabulating the returns of the separate colleges, we shall tabulate only one course of each, taking the civil engineering course when there is one, the mechanical course when there is no civil, and the mining course only when there is no other engineering course at the same college. The only exception to this rule will be the colleges of civil and of mechanical enginering at Cornell University each of which is separately managed and a very large and important school. As a rule, the parallel engineering courses at colleges having more than one are laid out on much the same lines, so that the main features and general tendency of each course can be inferred from the one given, in connection with the following:

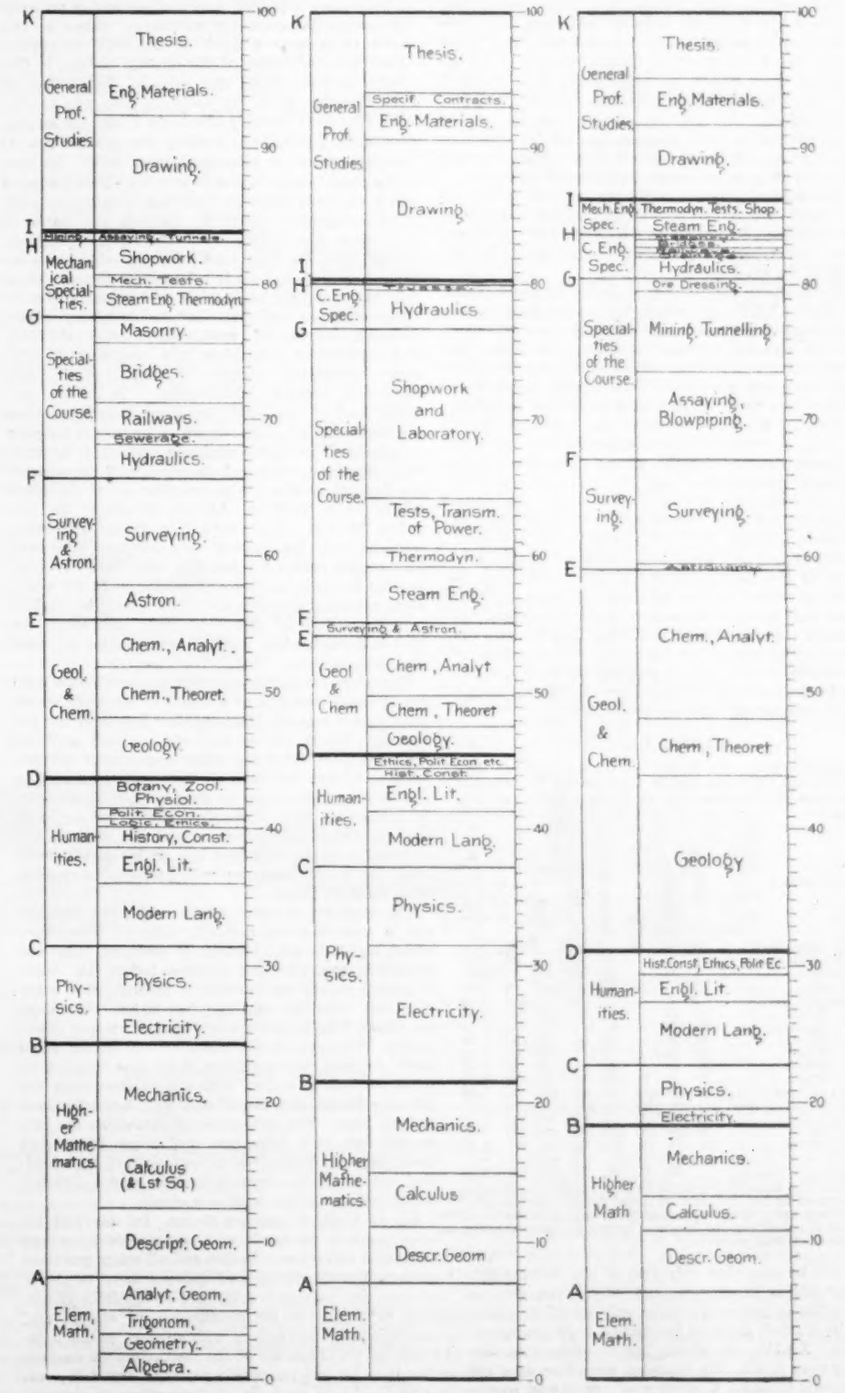

Civil Engineering (Mean of 15 Colleges).
Mechanical Engineering (Mean of 12 Colleges).
Mining Engineering (Mean of 8 Colleges).

DIAGRAM ILLUSTRATING APPROXIMATELY THE MEAN DISTRIBUTION OF TIME TO THE SEVERAL STUDIES OF ENGINEERING COURSES AT AMERICAN COLLEGES

To indicate approximately what the general average of each course is, and what the typical differences between the several courses are, we have selected the following list of 16 engineering schools whose returns we have arranged for their civil, mechanical and mining courses separately (so far as they have these) with results shown in the accompanying diagrams and table. These schools are: Massachusetts Institute of Technology, Boston, Mass.; Cornell University, Ithaca, N. Y.; Rensselaer Polytechnic School, Troy, N. Y.; Columbia School of Mines, New York City, N. Y.; Lawrence Scientific School, (Harvard), Cambridge, Mass.; Stevens Institute of Technology, Hoboken, N. J.; University of Michigan, Ann Arbor, Mich.; University of Pennsylvania, Philadelphia, Pa.; University of Illinois, Champaign, Ill.; University of Wisconsin, Madison, Wis.; University of Minnesota, Minneapolis, Minn.; University of Kansas, Lawrence, Kan.;

Rose Polytechnic School, Terre Haute, Ind.; Purdue University, Lafayette, Ind.; University of Georgia, Athens, Ga.; Swarthmore College, Swarthmore, Pa.

These all seem to have, judging from the returns, very fair shop, laboratory, and instrumental facilities, and to have thorough courses of study laid out which occupy four years for their completion. Some other four-year schools are certainly more deserving to be placed in this category than some which are found there, as Lehigh University for instance, from which no information was received in time for its use as to the time devoted to different subjects. All but one of these schools, or 15, give courses in Civil Engineering; all but four, or 12, have courses in Mechanical Engineering, whereas but 8 of them have courses in Mining Engineering.

These 16 schools ordinarily graduate about half of all those graduated in the 52 schools tabulated. These schools indicate with tolerable accuracy, therefore, the typical engineering course given in the United States.

We postpone until our next issue the presentation of Table XXV. on which the accompanying diagrams are based and which will only show averages, not the separate returns, in order that it may be compared with the other tables to follow. To show that there is a good deal of uncertainty about such an average, however, and also to convey useful information, we have compiled the following Table XXIV., showing for these same colleges the time in hours reported for the several branches of elementary mathematics and for the calculus, with the ratio between the two. The larger this ratio, of course, the more elementary is the instruction at the given college. At least, that is a fair inference, though it may be unjust to some extent in this, that some of the colleges prefer to give more time to other advanced studies and less to calculus. The mean time given to elementary mathematics and the calculus together from which there are but two extreme variations is 369 hours, or just one-sixth of the whole course in civil engineering (still less for the mechanical and mining courses), which cannot be considered an extreme proportion.

TABLE XXIV.

Relative Time (in Hours of Entire Course) Devoted to the Calculus, and to the General Elementary Branches of Mathematics at Sixteen Different Colleges.

College.	Number.	Algebra.	Geometry.	Trigonometry.	Analyt. Geom.	Total Elem	Calculus.	Ratio Elem. to Calculus.
Mass. Inst. Tech....	11	28	32	70	45	175	95	1.85
Cornell University...	14	60	..	60	60	180	120	1.50
Rensselaer.....	1	68	40	40	43	191	73	2.65
Columbia.....	9	..	50	62	56	168	56	3.00
Lawrence.....	2	..	..	57	57	114	114	1.00
Univ. Mich.....	6	54	..	..	90	144	180	0.80
" Pa.....	25	80	..	60	180	320	240	1.33
" Ill.....	38	70	..	55	55	180	180	1.00
" Wisc.....	27	95	..	58	75	228	143	1.59
" Minn.....	34	60	..	48	48	156	96	1.63
" Kan.....	33	47	47	49	82	225	82	2.75
Rose Pol. Inst.....	47	148	125	50	88	411	230	1.79
" " " (corr'ed)		(49)	(42)	(17)	(29)	(137)	(77)	(*)
Purdue.....	46	90	135	71	64	360	144	2.50
Univ. Ga.....	16	120	120	120	60	420	120	3.50
Swarthmore.....	29	72	72	32	72	248	144	1.73
Mean.....		66	41	56	72	235	134	1.75

NOTE—The Rose Polytechnic figures should be divided throughout by 3 to compare on equal terms with the others. They are given as returned however, as they were so used in compiling the diagram before the more correct information was received.

It will be seen that only two of the colleges give no instruction in algebra, and only seven give no instruction in geometry, while only one(if its report may be trusted) gives no instruction in trigonometry.

Table XXIV., on which the accompanying diagrams were based, was compiled some time ago, and its records included a number of errors and irregularities which have been since corrected, one of the most important of which is noted beneath Table XXIV. The Rensselaer return perhaps errs by omission, as we have been notified that it is in some respects defective and returned it for correction.

In the accompanying diagram we have made one change from the classification given at the beginning of this article. We have made Class G in each case the studies special to each course, and Classes H and I the studies special to the other two courses. This we did in order to bring the studies special to each course in the same relative position in the diagram. Each course must also give more or less time to the specialties of the other two courses, naturally.

One puzzling question, at least, seems to be answered clearly enough in the accompanying diagram, viz., why the mining courses are so rapidly falling into innocuous desuetude. The average mining course as shown on the diagram would seem to be a most ill-judged course, from which no possible student can gain any advantage, unless he proposes to become a kind of scientific prospector. What are the duties of the mining engineer? One would suppose from the average distribution of time that the college conception of him was as of a man who goes roaming about the earth for strange geological formations, hunting for new rocks to analyze, assay or blow-pipe, from which he may get a good "show" for a new mine. The imagined being does not exist, at least not in numbers sufficient to warrant schools for training him, as he is at a great disadvantage with the rustler for grubstakes when he does exist. On the contrary your typical mining engineer is a humdrum sort of fellow who takes a mine as it exists and contents himself with managing and extending its machinery, plant, reducing works (if any), drifts and shafting, and accurately surveying and mapping it, with some occasional simple chemical work. Except for general information he has no more need of profound geological knowledge than his workman; all he knows which he uses practically he acquires just as his workmen acquire it, by practical experience with and observation of the particular formations that he is working in at the place where he is working. All the chemistry he uses (when he uses any) are a few routine processes, soon learned, for dealing with his particular ore. His special reason for being is that there are engineering duties connected with mining work for which some special training is necessary. But the kind of training needed for this is precisely that which the civil and mechanical engineer gets, not at all what the chemist gets.

Therefore the mining engineer who graduates from the average course is at a disadvantage even on his own chosen ground. He is neither fish, flesh nor red herring. He is not so good an engineer as those who graduate from the other engineering courses, because he has not been so thoroughly grounded in engineering. He is not so good a chemist as those who graduate from a chemical course for the same reason. Other things being equal the civil or mechanical graduate will beat him on his own ground, while he is not nearly so well qualified to compete with them on theirs.

The qualities of mind which make the engineer are in some respects radically different from those which make the good chemist or geologist. The one is mainly practical and requires before all things a certain energy and executive faculty; the other is purely scientific and requires before all things an almost infinite patience and love of minute observation. The two do not combine well in the same man; the man who combines them best will not be quite the best in either. Our mining companies are growing larger and larger and will have the best in both lines. The conception of combining the two in one man is a false one, and hence fewer and fewer take the course, which we fear have been modeled too closely on German models, where different social and industrial conditions obtain.

So, at least, it appears to us. In this and all other matters we speak with some reservation and subject to correction. In this and all other questions connected with schools and colleges there is plenty of room for legitimate difference of opinion. Especially in regard to the distribution of studies and comparisons of one college with another, so much depends on the character of the instructors themselves that it is all but impossible to make any fair comparison. As to methods of instruction, it may be said to be almost entirely from text books, either regularly printed and published, or printed off by some one of the various modern processes of duplication, so that the students have the full text of the course placed in their hands.

Of course this text is amplified, supplemented, and explained by lectures, or rather conversational talks, but the gist of the work is now generally placed in what is regarded to be its proper form in the student's hands. The lecture system proper is passing out of vogue, as text books are published fully up to date, and suitable to serve to replace the oral instruction formerly given by the professor. The books now used wholly or in part by engineering students in our better grade of schools make up a very handsome working library for an engineer, comprising as they do from 20 to 40 volumes of current engineering and scientific literature of standard value.

The professors, also, are now usually graduate engineers of considerable practical experience as designing or assistant engineers, whereas a few years ago they were usually teachers of mathematics with little or no engineering experience. A bright boy just graduated from college is no longer considered a suitable person to teach engineering until he has had a few years of field or office experience. With men of practical experience in charge of our engineering schools, and with all the shops, laboratories, models, instruments, and appliances now commonly forming a part of the plant of all good engineering schools, the young engineering graduate of to-day is a very different product from that turned out a quarter of a century ago when the professors were mostly skilled in pure mathematics and mechanics simply, and shops, laboratories and field practice for the students were almost unknown. The change which has already begun will doubtless go still further, but an examination into the workings of any one of our good engineering schools today would probably be a revelation to any engineering graduate of a dozen or more years ago, who has paid no attention to the subject since.

UNION COLLEGE.

Sir: In your table of hours devoted to studies in technical schools I notice you give but 40 to field work in Union. There must be some mistake or misunderstanding of the figures furnished you, for the actual number of "catalogue hours" devoted to field work and plotting of field notes is about twice 40, and the actual time spent in the field and in plotting is at least five times 40. I have noticed some minor errors in the statistics of the college, but this seemed of sufficient importance to mention. I may say that the amount of field work will shortly be increased by the addition of about three solid weeks of vacation work.

Yours respectfully,
Chas. C. Brown.
Professor of Civil Engineering.

Schenectady, N. Y., Sept. 24, 1892.

(Prof. Brown's return, which lies before us, specifies nothing whatever for field or shop work, except two bracketed totals applying to two columns jointly, which we apportioned according to our best judgment, according to our general rule not to apportion more than was certainly proper in such cases.—Ed.)

PREVENTION OF DROUGHTS.

In a recent number of "Le Genie Civil," of Paris, General Annenkoff, the Russian railway engineer in charge of the Trans-Siberian Railway, states that the provinces of the east of Russia have suffered from successive droughts in recent years, and that in 1891 there was a failure of the crops in 21 provinces with 35,000,000 inhabitants. These droughts arise from a gradual change taking place in the climate, due largely to the destruction of the forests along the banks of the affluents of the principal rivers, and also in part to the removal of obstructions in the rivers for the purpose of facilitating navigation. Rain and melted snow find their way to the sea much more quickly than formerly, and, therefore, a smaller proportion of the moisture is absorbed by the soil. Floods are more violent and more quickly passed, and the low-water level of the rivers is permanently lower than it used to be. The rivers chiefly affected are the Volga and the Don. The Director of Public Works has decided to take methods to remedy these evils. Artificial lakes or ponds are to be established in the ravines from which the various affluents of the rivers flow, retained by small dams wherever they can be cheaply constructed, and on the plains long banks are to be thrown up, against which snowdrifts will be formed. The snow thus accumulated will melt more slowly than the thinner covering on the rest of the soil, and will find the ground thawed and absorbent when it does melt. In some parts of Russia the peasants have long been in the habit of storing water in this way, using walls of plank to intercept the snow, and it serves them until August. The first of these works have been commenced in some tributaries of the river Don.

THE KRAG-JORGENSEN RIFLE.

Along with the press generally we have been misled into describing the original Danish army rifle as the weapon lately recommended by the army board of experts for use in the United States Army. The accompanying drawings are taken from official sources, and for their use we are indebted to the courtesy of the "Army and Navy Register," of Washington, D. C.

In the first place, the inventors, Krag and Jorgensen, have materially modified their Danish gun and submitted a greatly improved and different weapon. The most important difference is that the magazine gate is now hinged on the under side, instead of at the forward end as on the Danish gun, and it opens downward instead of horizontally toward the muzzle. Fig. 1 illustrates the operation of this gate. Here m is the thumb-piece by which the gate is opened and closed; n is the feed plate, which exerts a continuous pressure upon the cartridges when the gate is closed, pushing them toward the barrel as they are consumed until the last one is in the position b. In the operation of filling the magazine the "clip" containing the five cartridges is emptied into the magazine and is not itself inserted, but thrown away.

Figs. 2 and 3 need but little explanation to the eye of an expert. The bolt c is a cylindrical tube sliding in the receiver. It is pierced for the firing pin and side projects to form a locking lug when pushed home and the lever turned down. When drawn back there is another lug to check the motion and fasten it open. This single motion operates the extractor, flinging the empty shell out to the right while another shell is admitted to the left, the last part of the pull-back sets the firing-pin spring, and the trigger is then set ready for a discharge. A small thumb-piece on the magazine top enables the cartridge in the magazine to be retained there and the arm at once become a single-loader, taking the cartridge from the top in very similar fashion to the present Springfield. The magazine may be charged to its capacity when partially empty, and it may be readily emptied without firing.

The gun as submitted to the army board has no outside steel barrel-casing and air space, as often described. The barrel is a solid piece of steel with a wooden casing forward of the magazine for the protection of the hand of the user against the heat developed by modern powder. The Chief of Ordnance, in approving the report of the board, recommends that this type of rifle be selected for trial with the view to adoption in the United States Army, and that questions of a proper caliber, ammunition, sighting, rifling and some minor details be determined hereafter by a board of ordnance officers to be appointed for this purpose. General Schofield has concurred in this recommendation and the Acting Secretary of War has approved—"as recommended by the Chief of Ordnance and the Major-General commanding"—and has dissolved the original board.

The members of the army board of experts signing the final report of Aug. 19, 1892, were Robert H. Hall, Lieutenant-Colonel, Sixth Infantry; J. P. Farley, Lieutenant-Colonel Ord. Dept., U. S. Army; H. B. Freeman, Major, Sixteenth Infantry; S. E. Blunt, Captain, Ordnance Department, U. S. Army; George S. Anderson, Captain, Sixth Cavalry.

This board was originally constituted by general orders of Nov. 24, 1890, and its composition was modified by a number of succeeding orders. This board was originally required "to consider and recommend a suitable magazine system for rifles and carbines for the military service." Later instructions required an opinion on the .30 in. Springfield single-loader and its ammunition, and an opinion as to the "relative merits of a magazine arm and a single-loader for use in the United States service." The board reported on the questions as follows, reference being had to two previous reports of Nov. 3, 1891, and July 28, 1892.

In all 53 guns have been subjected to trial, including, besides the product of different private inventors, both American and foreign, the small arms officially adopted for the armies of the following countries, viz.: Austria-Hungary, Belgium, Denmark, England, France (for cavalry), Germany, Japan, Portugal, Roumania, Russia and Switzerland.

Each of the different magazine guns examined can be placed in one or two general classes, dependent upon the manner in which their fire can be delivered.

First. Those which while the magazine is charged cannot be used as single loaders. These arms should more properly be termed repeating guns.

Second. Those in which the magazine can be charged and then held in reserve while single fire is delivered, magazine fire being, however, available at any moment.

Therefore guns of the first-class can be employed as single loaders only when the magazine is empty; those of the second class when it is either empty or loaded.

The small arms of Austria-Hungary, Germany and Roumania are typical of the first class; for them the cartridges are habitually carried in the ammunition trains, and by the soldier in packets of five, the packet being introduced bodily into the magazine.

Typical of the second class are the small arms of Denmark, England, Switzerland, and the improved Mauser gun. With the best developed of this class the cartridges are carried by the soldier both singly and in packets, the latter being employed to facilitate rapid charging of the magazine though not essential thereto.

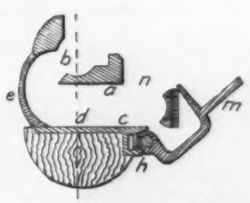


Fig. 1. MAGAZINE GATE.

This classification compelled the board to consider not merely the mechanical features of the guns it has examined, but also their merits and defects as an armament; and from such consideration the board is of the opinion that magazine systems of the second class are more "suitable" for our service than those of the merely repeating type.

A number of guns of both classes were subjected to supplementary examination and test, the Springfield 0".30 single loader being introduced as a standard of comparison.

These and the previous trials showed to the entire satisfaction of the board that the bolt system of breech closure, as developed in the last few years, and particularly for arms of the reduced caliber, is superior as a single loader in case of manipulation, facility of loading and rapidity of fire, to an arm on the block system like the Springfield, and has the additional advantage that without sacrificing any of its features it is also adaptable to use as a magazine arm.

Added to the differences of breech mechanism brought before the board, there has been a further complication of the subject incident to the cartridge employed; these have had flanges like those at present in our service, while others have been flangeless with cannelured heads.

Attendant upon the manufacture of the latter, and exact adjustment to the guns in which they might be used, are many difficulties not experienced in the manufacture and use of the flanged shell.

Recognizing all these conditions, the board has unanimously arrived at the conclusion that an arm showing itself to be an efficient single loader, a rapid magazine arm, holding meanwhile that magazine in reserve with a cut off plainly indicating to the officers which class of fire is being delivered and a system adaptable to either a headed or a flangeless shell, was the most "suitable" for our military service of all examined.

Such a system is found in the Krag-Jorgensen guns as improved and ultimately submitted to the board. Two of these guns were finally examined, one taking a flanged, the other a rimless shell; they appear to be of equal merit, but on account of the difficulties that might possibly attend the use of the latter class of cartridge, the board recommends the adoption of the gun for the flanged head known on its records as Krag-Jorgensen, No. 5. This arm is a decided modification of and an improvement upon the weapon of the same name now in use in Denmark.

As to the "relative merits of the magazine arm and a single loader for use in the United States service" the board deems that its opinion has been already expressed in the previous remarks, but that no doubt may exist as to its position the board adds that it considers such an arm as this Krag-Jorgensen, No. 5, which is capable in a high degree of both single loading and magazine fire, to be vastly superior for use in the United States service to any weapon adapted to single loading fire only.

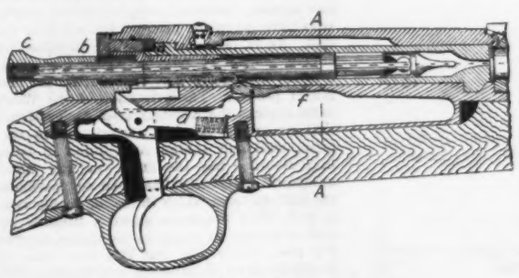


Fig. 2. Section Through Breech.

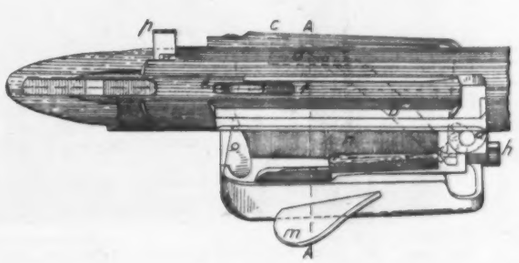


Fig. 3. Breech Mechanism.

THE KRAG-JORGENSEN RIFLE.

Cut shows gate open; *m* is the thumbpiece; when gate is closed takes position *b* shown by dotted lines. Projection *p* regulates use of gun as magazine or single loader.

IRRIGATION IN THE WESTERN UNITED STATES.

The extent and distribution of the irrigated areas of the Western United States was shown by a map in our issue of Sept. 29. Some further information regarding irrigation in the section named is given below, it also being taken from Extra Census Bulletin No. 23.

The average cost per mile of constructing irrigating canals in the Western United States is given as $481 for canals under 5 ft. in width; $1,628 for widths from 5 to 9 ft.; $5,603 for widths of 10 ft or over. California shows the highest average cost, the average cost of the three widths named being $885, $5,957 and $15,511.

The average first cost of water rights per acre is reported as $8.15, ranging from $3.62 in Wyoming to $12.95 in California. The average annual cost of water per acre is reported as $1.07, ranging from 44 cts. in Wyoming to $1.55 in Arizona. The subhumid states, in both cases, are not separately reported.

The average duty of water for irrigation in the several states is variable and cannot be stated with accuracy, but 100 acres per second-foot is considered as the average duty obtained under favorable conditions with ordinary skill on the part of the irrigator. It is thought upon the new land of Utah, Idaho and Montana an average duty of 70 acres per second-foot is obtained and that this duty can be increased to 100 acres. In California as high a duty as 200 acres has been obtained where water was scarce and carefully used, and in exceptional cases a duty of 500 acres is reported in connection with orchards where water is said to be piped to each tree.

The same bulletin contains a compilation of gagings of the flow of several rivers and creeks located in ten states and territories, which will be welcomed by many engineers. The figures were taken from

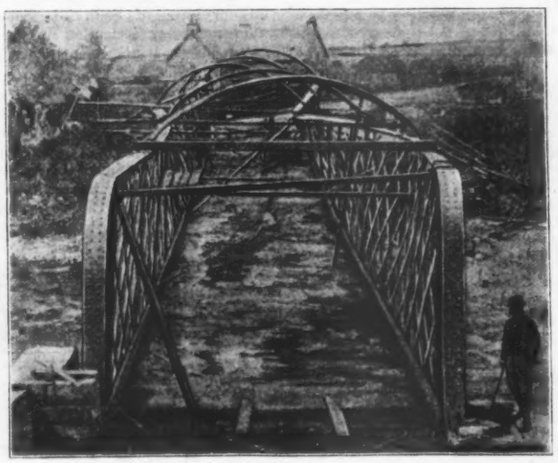
recent reports of the United States Gological Survey, of the State Engineer of Colorado and from a report compiled by the State Engineering Department of California, under the direction of Mr. Wm. Ham. Hall, M. Am. Soc. C. E., and published in 1886.

The maximum, minimum and mean discharge in second-feet is given for many of the streams reported on, and the contributory drainage area is generally stated. All of the California gagings (121 streams) made under the direction of Mr. Hall, extended over the six years, Nov. 1, 1878, to Ooc. 31, 1884. The other gagings range from single observations to those extended over seven years, the Cache la Poudre, above Fort Collins, Colo., having been gaged by the state Engineering Department of Colorado during the spring, summer and early fall of the five years, 1884 to 1888, and during the whole of the two years and five months from Jan. 1, 1889 to May 31, 1892.

The gagings of the Sacramento River, at Sacramento, Cal., to give the figures for one stream, for the six years, Nov. 1, 1878, to Oct. 31, 1884, showed a maximum flow of 160,000 sec.-ft., a minimum of 5,050 sec.-ft. and mean flow of 37,632 sec.-ft. The drainage area of the river above this point is 26,187 square miles, so that the maximum, minimum and mean discharges per square mile for the six years were 61, 0.2 and 1.4 sec.-ft.

A STEEL BRIDGE FAILURE AT STRATHGLASS, SCOTLAND.

From our English contemporaries is obtained the following material relating to the failure of a new bridge at Strathglass, in Inverness-shire, Scotland.



FAILURE OF THE CANNICH BRIDGE, STRATHGLASS, SCOTLAND.

The story of the failure is valuable chiefly as a lesson to "economical" county authorities; the bridge engineer will readily read the cause of the disaster in the design.

The Inverness County Council called for designs and tenders together, and accepted a low offer of $6,450, as compared with a tender of $12,150 made at the same competition by Sir William Arrol's firm, the builders of the Forth Bridge. The bridge was practically finished when the buckling of the compression members occurred. The workmen were engaged in spreading the road-metal over the bridge floor, 30 cu. yds. out of a total of 40 cu. yds. being in place at the time.

As erected the bridge was 130 ft. long, and 18 ft. wide, and was designed to carry a load of 20 tons, centrally, or 40 tons distributed. The latter assumption would amount to about 37½ lbs. per sq. ft. of roadway, or less than half of the usually assumed load.

The girders were of steel, 130 ft. long and 13 ft. high, latticed. "Engineering" says that the top compression member was made of two 12-in. plates, ½ in. thick, connected by two 4 × 4 × ½ in. angles; giving a total area of 19.5 sq. in. without deducting rivet holes. The bottom chord was much heavier, and was made of two 16-in. by ¾-in. plates, with two 4 × 4 × ½-in. angles. The lattice bars in tension were 5 × ½ in. flat bars; and the compression members were 4 × 3 × ½-in. tees, the openings being about 30 ins. square. Each girder was divided into ten bays of 13 ft. each, by inside and outside vertical stiffeners made of 4 × 3 × ½-in. tee-irons. The only lateral connection for the top-chords were five arched stays built up of one 6 × ½-in. plate and two 3 × 3 × ⅜-in. angles, the shallow sides of the channel thus formed being vertical. The estimated weight of one girder was about 47,000 lbs. The flooring was made of Bailey's steel troughing, weighing about 32½ lbs. per sq. ft. These troughs were filled and asphalted and the bridge was to carry 40 cu. yds. of road metal in addition.

From the above it may be learned that the total designed dead load was fully 90 tons on each girder; and at the time of the accident it was 80 tons. Including live load, each girder would have to carry about 110 tons. Taking the effective depth of the girder at 12½ ft., the total maximum compression on the flange of the girder would be about 143 tons; and this was about 104 tons at the time of failure. With 19.5 sq. in. as the gross cross-sectional area of the top-chord the strain due to the maximum load would be nearly 7½ tons per sq. in., a permissible strain on steel under suitable conditions.

But these conditions were not suitable, and the provision against buckling was totally inadequate and absurd, and by buckling the bridge failed under a strain of about 5½ tons per sq. in. The arched top-stays were without diagonal bracing, and the "stiffeners" were far apart, light and cranked out to pass the lattice bars, thus diminishing what little stiffness they had. Fortunately the bridge settled down on the erection platform still under it and was thus saved from total wreck.

We can only say with "Engineering" that there can be little sympathy with the County Council in the sudden collapse of their efforts to obtain a cheap bridge. And it may be added that they will probably, in the future, allow the question of design and fitness of any other bridge they may build to be settled by a competent engineer rather than by the mere amount of cash the structure is nominally to cost.

THE WANING POWER OF THE AMALGAMATED ASSOCIATION.

The non-union iron and steel mills of the United States employ over 100,000 men, according to statistics collected by the "Iron Age." Practically all the mills east of the Allegheny Mountains and north of the Potomac River, with the exception of two mills in the Philadelphia district, are non-union. The strength of the Amalgamated Association is now only in the Pittsburg district and in the Mahoning and Shenango valleys. The "Iron Age" points out the very interesting fact that as iron and steel is now bought largely on specifications and tests and not on the manufacturer's reputation the manufacturer is more independent in his relations with his labor. The improvements in technical practice have also tended to weaken the power of the union. We quote as follows from our contemporary:

Margins are narrower now than they were in the earlier days, so that a contest does not cost so much as it did then, and success, with its absence of the harrowing mill committee and better control of the business, means more. Then, too, the majority of our iron manufacturers are financially stronger than they were, and need not dread maturing obligations so much. As sellers, the manufacturers have learned that the loss of trade is not a calamity. If they are in a position to make the price attractive, the business will come to them after months of idleness. Ownership of customers no longer exists, and with it has gone the fear that rival concerns may acquire such proprietary rights. Inability to supply "regular customers" for a time has lost much of its terror, and a temporary withdrawal from the market caused by idleness of plant is borne with more complacency on that account. When iron and steel products were exclusively sold, so far as their quality was concerned, on the simple reputation of the producer, there might be some danger that in time of idleness rival brands might gain a foothold. Now the great bulk of finished iron and steel for a great variety of structural purposes is bought on specifications and not by brand. The price, not favor, settles where the order is placed. This makes the manufacturer more independent, so far as his relations with labor are concerned, because he is freer in his relations with his customers.

A potent influence in lessening the power of the Amalgamated Association is the rapid decline in puddling. The puddlers have always been the backbone of that organization. Their exhausting labor calls for considerable skill, and their places cannot be quickly supplied by untrained men in large numbers. It is different in the manufacture of soft steel, the successful rival of puddled iron, and there is this additional fact—that the number of men for a given product is far less than it is in a puddling mill. With the declining number of active puddling furnaces the number of skilled men available for those which are still running will increase, and will bring uncertainty into the ranks of the most influential body of men in the Amalgamated Association.

In the finishing mills improvements in technical practice have also tended to weaken the power of the union. Automatic machinery has taken the place of those skilled in handling the material. The times have gone by when a boss roller could cause consternation and long delays by simply drawing the wedges used in the adjustment of rolls. Any intelligent machinist can soon learn how to handle a train, and the drafting room has already furnished many ambitious young graduates who have taken the place of the old time tyrant of the mill. As in other pursuits, the introduction of labor-saving machinery has increased the earnings of individual men, while heavily reducing the labor cost per ton of product. The grievance of the Western rolling mills against the Amalgamated Association is that the mill owner has not had his fair return for his enterprise, skill and energy contributed to bringing about that result. But the effect of the introduction of automatic machinery has been to enormously enlarge the sources from which the labor supply can be drawn. A man need not have spent a lifetime in a rooling mill to become an expert in the duties for which it calls. We need hardly add that this fact, too, weakens the power of the Amalgamated Association.

It is a fact, too, which the iron and steel trades should face without flinching that with the rapid and cheap transportation in this country, the differences in the rates of wages paid in various parts of it are bound to disappear. Those who throw obstacles into the way of this natural law are bound to suffer for it at some time. An arbitrarily high rate can as little remain permanent as an unduly low one.

A RAILWAY COMMERCE CONGRESS.

The arrangements for the Congress on Railway Commerce at the World's Columbian Exposition have been placed in the hands of a strong committee, comprising Messrs. Geo. R. Blanchard, Aldace F. Walker, John Newell, M. M. Kirkman, John W. Cary, Geo. B. Reeve and others. The subjects to be considered by the congress are as yet undetermined, but they will not include matters under the head of railway construction, equipment and operation, which have been assigned, very properly, to the department of engineering. The following subjects are suggested for consideration:

a. The origin, development and present condition of railway commerce in different parts of the world.
b. The influence of railway commerce on the settlement and development of new countries.
c. The practical results of railway commerce to producers, carriers and consumers.
d. The proper elements of the cost of safe and efficient service.
e. The practical effects of free competition in the construction and operation of railway lines.

f. The proper protection of the public rights and interests involved in railway commerce.
g. The proper protection of private rights and interests involved in railway commerce.
h. Railway strikes; what should be done in the way of prevention and control.
i. Railway employees; what should be done for their protection and improvement.
j. Railway accidents; their causes and the practical safeguards against them.
k. Railway receiverships; the practical lessons they teach.
l. Governmental regulations of transportation and practical results thereof.
m. Freight traffic; special contracts, limitations of common law liabilities, railway clearing houses, traffic pools, etc.
n. Baggage; checking systems and delivery; claims for damages, limitations of liability; restrictions of quantity, etc.
o. Passenger tickets; defects of existing systems; special contracts and conditions; limitations of time; through tickets; commutation tickets; zone tariffs, etc.
p. Police power of railway train officials, and the best means of guarding against frauds on the carrier, and against injury to passengers through accident or mistake.
q. Interstate and international railway arrangements; their practicability; the best means for their promotion and their influence on the commerce, peace and prosperity of the world.

The president of the World's Congress auxiliary is said to be the author of the above list of subjects, which are published "for the purpose of eliciting from all who may be interested the recommendation of such additional or different topics as may be deemed proper for the occasion."

Communications are invited from railway commissioners and officers of railway companies throughout the world, suggesting to the committee the themes which it would be most useful to consider in the proposed congress, of the persons by whom such themes may most advantageously be presented, and of the modes of proceeding by which the most satisfactory and useful results may be secured.

Such communications should be addressed to the chairman of the committee, Mr. Geo. R. Blanchard, at World's Congress Headquarters.

INVERTED BOWSTRING BRIDGE; BOSNIAN STATE RAILWAYS.

This bridge, for the cuts and particulars of which we are indebted to the "Zeitschrift des Oesterreichischen Ingenieur und Architekten Vereines" (the dimensions on the cuts being in meters), is situated between Mostar and Serajevo, and spans the torrent of the Luka River at a height of about 187 ft. above the bottom of the gorge. On account of the heavy grades encountered by this line in crossing the Ivan mountains, the maximum grades being 6%, the Abt rack rail system has been adopted, the line being worked by locomotives on the combined adhesion and rack rail system. The bridge itself, of which Fig. 1 is a general view, is on a grade of 3%, and is on a rack-rail section of the line, laid with two rack bars. The Abt system and its applications have been many times described and illustrated in our columns.

The bridge is of the inverted bowstring truss type, 185-ft. span, and consists of two trusses, 8.2 ft. deep at the ends and 27.2 ft. deep at the middle. These trusses are spaced 10 ft. 6 ins. apart, and support plate girder floor beams, which are about 13 ins. deep where they rest on the top chords of the trusses, and 20 ins. deep between the trusses. The top chords are of trough section, each corner consisting of two angle irons, with lacing bars on the top and two sides. The bottom chord is also of trough section, with plate sides, and two angle irons to each bottom corner. The diagonal members are built up of plates and angles. The bottom chords are connected by horizontal bracing, and diagonal wind bracing is placed between the trusses. The elevation of the bridge is shown in Fig. 2. Fig. 3 is an elevation of the lower end, and Fig. 4 is a cross-section. Above the floor beams are two plate girder stringers 18 ins. deep, spaced 3.6 ft. apart, connected by horizontal bracing, and supported on the outside by plate gussets riveted to the stringers and floor beams, as shown in Fig. 4. To the top chords of the stringers are bolted the metal ties which carry the track rails and the chairs for the rack bars. These cross-ties are built up of two angles on each side, the upper ones riveted to a top plate, and the lower ones bolted to the stringers. A thick layer of felt is placed under the ties. The track rails are of T section, resting on Heindl tie plates and secured by bolts. The material of the bridge is Styrian wrought iron, of 45,000 lbs. to 52,600 lbs. tensile strength, 25% elongation, and 40 to 45% reduction of area.

Before being opened for traffic the bridge was tested with a tank locomotive, of the Abt system, weighing 68,000 lbs. in working order. The engine has six driving wheels 32 ins. diameter, and a single pair of trailing wheels behind the firebox. There are two pinions, 27 ins. diameter and about 4 ft. apart, c. to c. The driving wheel base is 7 ft. 6 ins., and total wheel base 16 ft. The adhesion wheels are driven by horizontal outside cylinders, 13½ × 18 ins.; while the pinions are driven by inclined inside cylinders, 12 × 14½ ins.

THE EARLY PILE RAILWAYS.

Travelers over the western end of the Erie, and over the Lake Shore road in northern Ohio and eastern Michigan, must have often noticed long

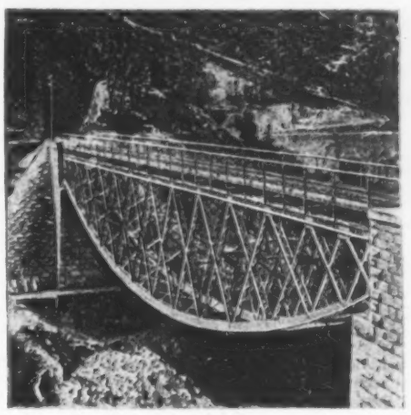


Fig. 1. Bridge Over the Luka River, Bosnia.

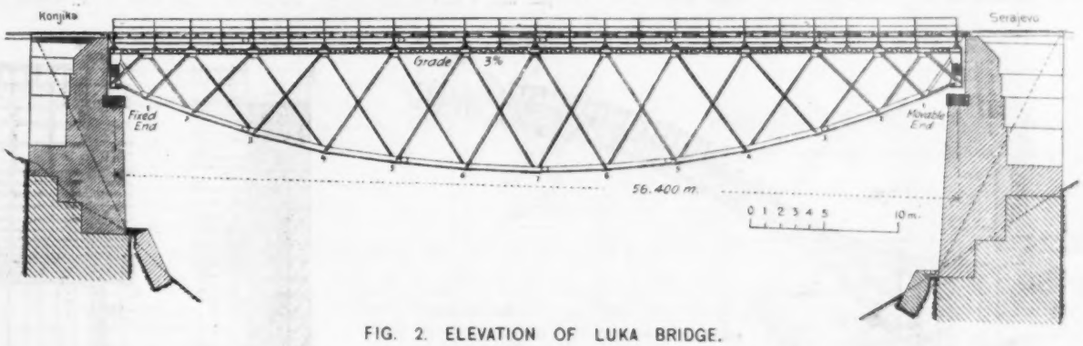


FIG. 2. ELEVATION OF LUKA BRIDGE.

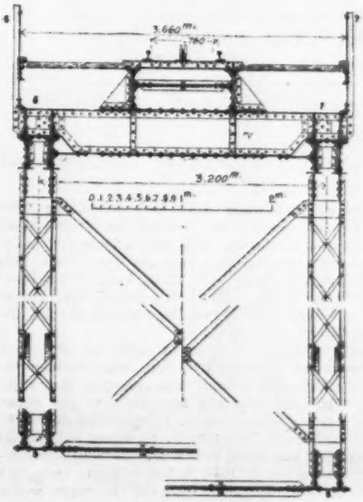


FIG. 4. CROSS SECTIONS OF LUKA BRIDGE.

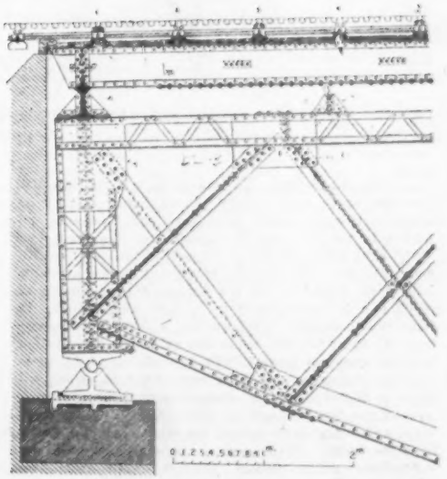


FIG. 3. DETAIL ELEVATION OF END OF BRIDGE.

double rows of piles, occasionally running through shallow cuts, and evidently intended for some form of railway. They are an evidence of one of the earliest delusions of American railway construction, provoked by a dearth of labor and superabundance of timber, that a railway perched throughout on piles would have the best possible roadbed at least equally delusive narrow-gage theory. The project and plan of construction for the Ohio Railroad referred to below are given very fully in a paper by Mr. C. P. Leland, on "The Rise and Fall of a Railroad Company, 1837-42," read in 1880 and printed in the 1881 volume of the "Journal of the Association of Engineering Societies." The substance of the story, as told in the "Times;" is as follows:

Scattered here and there across northern Ohio in a line between Painesville and Toledo, will be found piles driven in seemingly unaccountable locations, and now far decayed. These fast-disappearing piles are

the visible remains of one of the oddest, most peculiar, and most scandalous enterprises ever undertaken in this country.

The Ohio Railroad, as it was called in the articles of incorporation, was one of the schemes of the wild era of speculation, which preceded the panic of 1837, and no "boom" craze in the West to-day has been marked by wilder fancies than prevailed at that time along the south shore of Lake Erie. One sanguine individual predicted a solid city from Buffalo to Cleveland. At every indentation on the coast, town sites and cities were plotted, and speculation ran high. In 1836, one man paid $2,500 for a lot in Fairport, which his children, 50 years later, offered for sale at $200. Similar wild inflation existed throughout all this then sparsely settled section.

It was in such an atmosphere that the idea of a railroad built on piles to avoid the expense of grading was adopted. The project was the child of some fertile, hare-brained eastern speculator, who wanted a railroad built from New York City to the Mississippi, on this plan. The Ohio Railroad Company was organized in Painesville, April 25, 1836, under the laws of the state, which not only gave it the banking privilege, in addition to that of carrier, but enabled it to borrow most recklessly upon the credit of the state. Under what became notorious as the "Ohio plunder law," the state loaned its credit in 6% stock to the amount of one-third the paid-up capital. In other words, it became a partner in railroad and canal schemes to the extent of one-third interest, in such a way that a premium was put on dishonesty, and an inducement held out to rob the state. Under this law stockholders turned in land, town lots, right of way, and the like, at fearfully exorbitant prices, in order that upon it more state credit could be drawn. Thus, if a farm were put in at the true value, say $3,000, but $1,000 in state credit could be drawn; but if it was entered at $6,000, twice its value, $2,000, in state stock would be issued for it.

Under such a brilliant financial scheme as this, the men who were not satisfied to stick to the ground in throughout northern Ohio. He remarked that, "by reference to the map of the United States, and examining the routes of improvements completed and in contemplation, it will be seen that from Maine to Virginia, in the East and South, and from Lake Superior to Arkansas, in the West, they all concentrate and unite with your road." He continued, at length, with neither statistics nor precedents to help him, to paint a panorama that, read more than fifty years after, is calculated to turn the writer of circus-bill posters green with envy.

The project took three years to get on its feet, and the first pile was not driven till June 19, 1839, the place being near the present Lake Shore & Michigan Southern station, in Fremont. Work was prosecuted during the summer and well into the winter. Thirty miles of the road were built near Manhattan, in what Thomas Richmond, who was Chairman of the Finance Committee of the Board of Directors, described as "a swamp of tall grass." The President of the company was interested in Manhattan town lots, and wanted them boomed; hence the pushing of work at the western terminus.

The actual work of construction was almost without parallel in its uniqueness. One hundred feet in width was cleared through the forest, and along this path at the rate of 330 ft. per day for each machine the most peculiar railway construction circuses on record were put to work. The piles were from 7 to 28 ft. long, varying to meet the grade, and were driven by a machine consisting of two sills about 40 ft. long, and placed parallel with each other at a distance of 7 ft., the width of the track. At the forward end of these sills four timbers 30 ft. high were erected, between which half-ton hammers were drawn up and dropped to drive the pile. A circular saw, attached to a shaft projecting between these four "leaders," cut the pile to the proper grade, and the machine moved forward 10 ft., and proceeded to drive the next pair. Eight men were required to operate each machine. A tie 8 ins. square was fitted to each pair of piles, and pinned down with a 2-in. cedar pin, half a pint of salt being deposited in each auger hole to preserve the wood before the pin closed it up. Behind the piledriver, on the track that was being laid, was a locomotive sawmill preparing 900 lin. ft. of rails per day. These rails were stringers 8×8 ins. and 15 ft. long, "strap-iron" rails, 25 tons to the mile, being placed upon them. Behind all was a traveling boarding-house for the accommodation of the men.

In such a unique manner 63 miles of stilt road was constructed between 1839 and 1843, considerable traces of which still remain. The repeal of the "plunder law" in 1840 was the first blow to the enterprise, and the general financial collapse, together with quarrels among the Directors as to whose axe should be ground first and most, caused the financial abandonment of the project in 1843, before a single train had been run upon it. Ten years later the two roads, which have since been merged into the Lake Shore, were opened over nearly the same line between Toledo and Ashtabula, at a cost of but little greater per mile in that depressed period for earth embankments than the flimsy stilt structure would have cost under inflation.

Investigation by the State Auditor in 1843, after the bubble collapsed, showed that, until the repeal of the "plunder law" in 1840, "not a dollar had been collected from the stockholders; not a dollar was in the treasury as the basis of the state issue." The company had used its power as a bank to issue notes and "upon the expenditure of this character, the funds of the state were procured." Then, "they were used to redeem the circulation already out, and form the basis of a new emission, by which a new sum could be plundered from the public treasury." By this scheme the state was not only building the road and supporting the horde of officials connected with it, but was also a party to the infraction of her own laws and the plunder of her citizens by means of a fraudulent banking system.

their railroad building, as was to have been expected, bled the state unmercifully. Their lands entered on stilts that were higher than ever the road was expected to run on, and the result was the state lost every cent advanced to the Ohio Railroad Co.—in all, some $250,000. Some of the staggering figures at which land was turned in to the company in payment of stock can be appreciated by a few comparisons. In Brooklyn township, Cuhahoga Co., a farm of 333 acres was put in at $33,300, while the valuation for taxation in 1840 was less than $3,800. One-eighth of 20 acres in Ohio City, now the West Side, went in as equivalent to $6,000 in stock, though four years later it was on the tax duplicate at barely $20. This $20-property, under this law, netted the Ohio company $2,000 in state credit. Never was a more shrewd and unscrupulous deal worked through than this by which a railway on stilts, and half a dozen other railway and canal corporations came near wrecking the credit of the then young and sparsely-settled commonwealth.

The purpose of the stilt railway was, of course, to boom the towns on its line. It was to run from Richmond, on the Grand River, two miles from Painesville, to the paper city of Manhattan, three or four miles below Toledo, on the Maumee. The prospectus was issued by Cyrus Williams, a reputable engineer, who afterward won a high place in his profession

TRAINSHED OF THE MAIN PASSENGER STATION AT COLOGNE, GERMANY.

The use of arched roof trusses of large span for trainsheds and similar structures is becoming quite general in this country, and several roofs of this type have been illustrated in our columns. This type of roof is very generally used in Europe for large railway stations, and we illustrate this week the new trainshed of the main passenger station at Cologne, Germany, which is nearly completed. We are indebted to the "Centralblatt der Bauverwaltung" for the illustrations, which are accompanied, however, by somewhat meager particulars.

This trainshed is 836 ft. long and 302 ft. wide, and covers an area of 26,600 sq. yds. or 5½ acres. It consists of a central span 209.65 ft. in the clear, 78.7 ft. high in the center, and two side spans of 44 ft. each. The span of the main arched roof exceeds that of any similar structure in Germany, and approaches nearest in size the roofs of the trainsheds of the Grand Central Station in New York, which is 200 ft. span and 96 ft. high, and the St. Pancras terminal station of the Midland Ry. in London, which is 240 ft. clear span and 100 ft. high. The accompanying table gives the span and height of five trainsheds of this type, none of which are under 200 ft. span. The heights given are all clear height except that of the Pennsylvania R. R. station at Jersey City, N. J., which is to the pin at

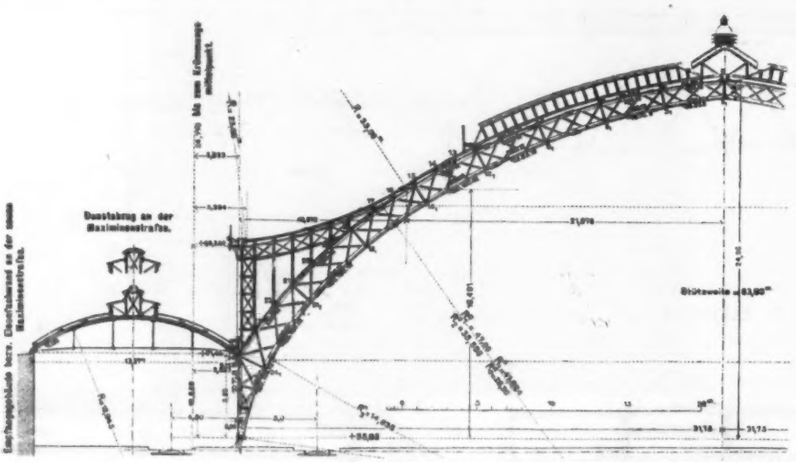


FIG. 1. CROSS SECTION,

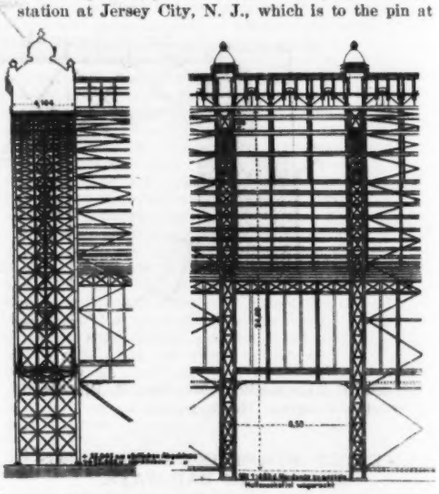


FIG. 2. LONGITUDINAL SECTIONS.

NEW PASSENGER TRAINSHED AT COLOGNE, GERMANY.

the crown of the truss. This trainshed is 652 ft. 6 ins. long and covers twelve tracks, and it was described and illustrated in our issue of Sept. 26, 1891. We are indebted to Mr. Walter Katte, Chief Engineer of the New York Central & Hudson River R. R. for the following particulars of the Grand Central Station, New York. The main trainshed is 650 ft. long, 200 ft. clear span, 96 ft. clear height, and covers twelve tracks. The annex, or arrival trainshed, has a triangular roof truss, and is 650 ft. long, 98 ft. 3 ins. clear span, 22 ft. 6 ins. clear height to lower chord of tie rod of roof truss, and covers five tracks. There are also two additional tracks in the alleyway between the two trainsheds, making a total of 19 tracks used in the train service of this terminal.

Station.	Span.	Height.
Philadelphia, Pa., Phil. & Read. R. R.	250 ft. 0 ins.	85 ft. 0 ins.
Jersey City, N. J., Pennsylvania R. R.	252 " 8 "	80 " 9¾ "
London, England, Midland Ry.	240 " 0 "	100 " 0 "
Cologne, Germany	209 " 8 "	78 " 7 "
New York, N. Y., Grand Central Station	200 " 0 "	96 " 0 "

The comparatively low outline of the roof of the Cologne station was adopted in view of its proximity

to the famous Cologne cathedral. A peculiar feature of this roof is the reverse curve of the lower portion, the cornice being about 41 ft. 6 ins. above the ground, and supported on posts 22 ft. high above the vertical part of the top or outer chord, upon which they rest, as shown in Fig. 1. A side elevation of the main trusses and end truss is given in Fig. 2. At the crown of the arch is a small clearstory roof and on either side of this, above the main roof, is a skylight, having the roof covering raised, and the sides of these skylights are left open for ventilating purposes. Each course of the corrugated iron roofing is made to lap 3.28 ft. over the preceding course, so as to provide additional space for ventilation. The total air space available for ventilation is 1,915 sq. ft. The main arch trusses are built up of two top and two bottom chords of T section connected by radial struts and lattice bracing.

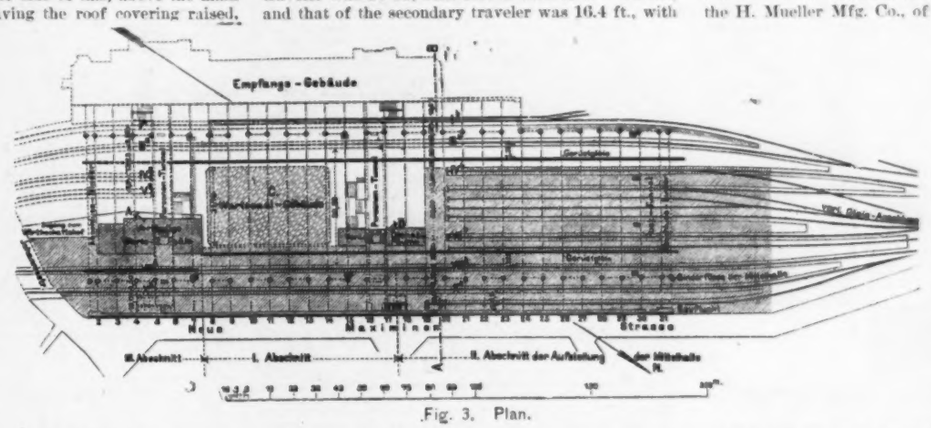


Fig. 3. Plan.

The two arch members forming each chord of the truss are spaced 31.5 ins. apart c. to c., and are connected by horizontal and diagonal bracing, as shown in Fig. 2. The trusses are spaced 27.9 ft. apart c. to c. The alternate bays formed by the main trusses are connected by sway bracing composed of round rods, and similar bracing is used at the three bays at each end of the trainshed, as shown in Fig. 2, two trusses at each end being spaced 13.4 ft. apart, with two intermediate trusses forming three bays, all provided with bracing as shown. The ends of the hall are closed by a glazed screen hung from the end truss. The arches of the two side spans are of segmental section, with a clearstory roof in the crown, provided with louvres in the sides. These trusses rest on the exterior wall and the top of the vertical portion of the main trusses.

The construction of this trainshed was attended by peculiar difficulties. As will be seen by the plan, Fig. 3, the temporary waiting room A, the offices B, and the main station building C, had to be entirely cleared by the traveler used in the erection of the arched trusses, so as not to interfere with the traffic. In order to clear the space to be occupied by the main station building C as soon as possible, the work of erecting the trusses was begun at the point 8 indicated on the plan, thence proceeding until point 31 was reached, and finally the trusses 7 to 2 were erected. In moving from point 8 to 31, the temporary offices B had to be cleared, and in returning to 8 the main building C, which had been erected in the meantime, had also to be cleared by the traveler, while from 8 to 2 the traveler had to be carried above the temporary waiting rooms A. On the plan the tracks used by the traveler are indicated by heavy lines, and in order to clear the temporary waiting rooms A, one foot of the traveler had to be changed to the position shown by the dotted lines in Fig. 4, and the outer black line in Fig. 3.

The traveler was of iron, and its construction is shown in Figs. 4 and 5. Its clear span was 127.5 ft., changed to 151 ft. during the latter part of the work, as above noted. In front of the traveler was a secondary traveler, shown in Fig. 5, for the hoisting and distribution of material. The combined traveler was carried by eleven pairs of wheels on each side. The width of the framing of the main traveler was 36 ft., sufficient to take in two trusses, and that of the secondary traveler was 16.4 ft., with a platform 21.28 ft. wide. As the width of the platform on top of the traveler was 41.3 ft., two trusses could be erected simultaneously without moving the traveler. The weight of the traveler complete was about 140 tons. The average time occupied in the erection of one arched truss was twelve days. The total weight of iron used in the construction of the trainshed, including the end screens and the corrugated iron roofing, is about 2,850 tons. The contract for this work was let to the Union Iron Works, Dortmund, Germany.

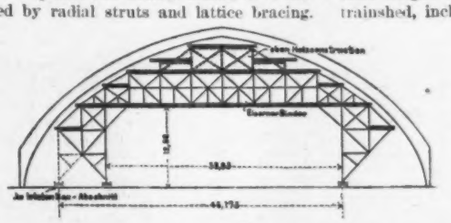


Fig. 4.

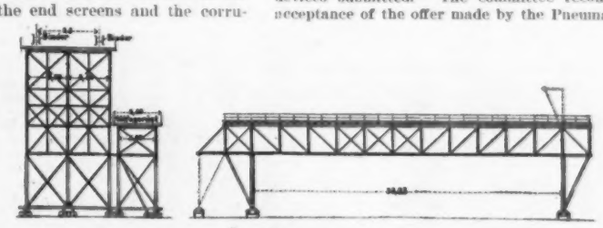
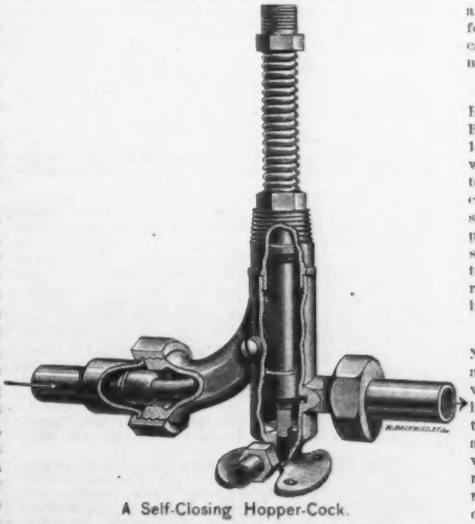


Fig. 5.

TRAVELERS USED IN ERECTING ROOF OF TRAINSHED AT COLOGNE, GERMANY.

A SELF-CLOSING HOPPER-COCK.

The accompanying cut represents a sectional view of a self-closing hopper-cock recently introduced.



A Self-Closing Hopper-Cock.

As shown in the illustration, it is very simple in construction, being operated without leather cups, washers or stuffing boxes. Both inlet and outlet are closed by Fuller balls made of rubber. The metal plunger closes off the outlet just before the ball is seated at the inlet-port, thus equalizing the pressure on the ball from both sides and allowing the spring to draw the ball slowly to its seat and without water-hammer effect.

The cup in the top cylinder is made of rubber, and does not become hard and crack, as is the case with leather cups. The spring can be compressed by screwing down the nut shown so as to permit the use of the heaviest closet seats. The makers, the H. Mueller Mfg. Co., of Decatur, Ill., claim for this device extreme simplicity, less repairs and less expense for repairs than with other types, and that it is adapted to any pressure.

Pneumatic tubes for rapid mail transit have been partially reported upon by the committees appointed by the Postmaster-General to examine into the various devices submitted. The committee recommends the acceptance of the offer made by the Pneumatic Transit Co., of Philadelphia, to lay a system of tubes between the general post office and the East Chestnut St. branch. This would be for the purpose of testing the system, and is without obligation on the Government's part to purchase or rent, and all work is to be at the expense of the Pneumatic Transit Co.

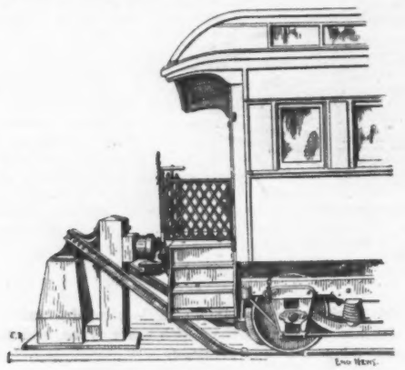
The long-distance telephone line, between New York and Chicago, is virtually completed, and will be ready for use in a few weeks. This is the line of the American Long Distance Telephone Co., and is the first commercial line between these points.

Curved armor-plate, which had been subjected to the Harvey process, was successfully tempered at the Bethlehem Iron Works, on Sept. 28. The plate weighed 14,000 lbs., and was 10½ in. thick, and the curvature was the same as for the turret plates of the "Miantenomah." Ice-water was used in tempering, and the contraction was very slight, and the plate was finally suspended in a tank of oil. As this curved Harvey-plate is of the same thickness, and has undergone the same treatment as the flat plates, so successfully tested at Indian Head and Bethlehem, the satisfactory result of this tempering experiment marks another important step in American armor-making.

The Abt rack rail system has been adopted by the Nilgiri Railway, in Madras, India, as already noted, and "Indian Engineering" says that in considering which of the systems hitherto employed for railways in mountainous countries was most suitable for adoption, the discussion was practically limited to the examination of the Fell central rail system, with gripping wheels, and the Abt rack system. The Abt system represents the most recent and improved form of the rack principle, while the Fell system depends entirely on adhesion. The Abt appears to have a slight advantage in point of cost and the Fell in the sharper curves admissible. The arguments in favor of either system are otherwise pretty evenly balanced; but, in considering the extent to which each has been adopted as an indication of practical success, a final judgment has been pronounced in favor of the Abt system.

THE ELLIS BUMPING POST.

An efficient bumping post at the ends of tracks in yards and at other places is a most desirable appliance to prevent the derailment of cars. The accompanying cut represents the Ellis patent bumping post, which is in use on a number of roads. The two track rails are bent up in the middle and brought together to a point, where they are bolted to each other and to a heavy casting supported by an oak block or stand behind the post itself, to which the deadwood and striking plate are bolted. The anchorage consists of an oak timber let into the ground about 5 ft. and connected by iron rods to a heavy cross bar clamped to the rails at the bend. The rails weigh 70 lbs. per sq. yd., are guaranteed



The Ellis Bumping Post.

to stand a tensile strain of 50,000 lbs. per sq. in., and are secured to the ends of the track by six-bolt angle bars. This form of post is easily erected, occupies little space, and has been in service for about six years with very satisfactory results. The Chicago & Northwestern Ry. has 49 in service, of which eleven are at the passenger station in Chicago, and have a rubber cushion to work against the Miller buffers of the cars. This rubber cushion attachment is specially made for passenger car service. The Ellis bumping post is manufactured by the Mechanical Mfg. Co., of Chicago, Ill.

CONSTRUCTION NEWS.

RAILWAYS

East of Chicago.—Existing Roads.

CHICAGO, MILWAUKEE & ST. PAUL.—This company is reported to have let a contract for building a branch from some point on the Ontonagon line to Houghton, Mich., which will give it a line to the copper districts in competition to the Duluth, South Shore & Atlantic Ry.

OHIO SOUTHERN.—The right of way has nearly all been secured for the proposed 70 mile extension from Springfield to Lima, O.

BOSTON & LOWELL.—This company has purchased 100 acres of land at Somerville, Mass., which is to be used for terminals, freight depots, etc.

PITTSBURG & WESTERN.—Work has been commenced on a branch to the Lowellville and Struthers blast furnaces, near Lowellville, O.

PHILADELPHIA & READING.—Surveys have been commenced for the Philadelphia & West Chester R. R. Co.'s proposed line from West Chester, Pa., to Exton Station, on the Chester Valley R. R. Geo. A. Aldrich, 1645 South Broad St., Philadelphia, Pa., is President of the P. & W. C. R. R.

PORTLAND & RUMFORD FALLS.—Proposals for the construction of a line from Mechanic Falls, Me., to a connection with the Maine Central, at or near Danville Junction, will be received until Oct. 24. Preliminary plans and profiles, specifications, etc., can be seen at the company's office, 34 Exchange St., Portland, Me., and plans and profile of location can be seen there after Oct. 17. Chf. Eng., Frederic Danforth. Two routes have already been surveyed for the line one 9 miles long, and the other 11½ miles long. A third line is now under consideration.

LAKE ERIE & DETROIT RIVER.—It is stated that tracklaying has been begun on the extension from Leamington, Ont., east. Ch. Engr. Jos. De Garse, Windsor, Ont.

NEW YORK & NEW ENGLAND.—Contractor Edward Ward has sublet the contract for grading the line from Pascoag to East Thompson, R. I., 7 miles, to Saneta Bros. and Maney & Sullivan. Work has already begun, and it is expected to have 600 men at work in a few days. It is expected to have the line completed by April, 1893.

WILKES BARRE & EASTERN.—About 25 miles of the grading on the line from Wilkes Barre to Stroudsburg, Pa., 60 miles, is reported completed. Work is making rapid progress.

OTTAWA, ARNPRIOR & PARRY SOUND.—A dispatch from Ottawa, Ont., says: "Construction is being pushed rapidly forward on the line from Ottawa toward Parry Sound, about 500 men being now employed on the road. The rails are laid as far as the Cedar bridge in the township of Admatson, where there is considerable trestle work to make. It is said that they will have this finished by the end of this week, and the rails will then be laid as far as Douglas, as it is expected that the grading to that point will be completed by that time. The road is being ballasted as far as the rails are laid. The line is being cleared west of Douglas, and the work of grading it will commence this week, and they are preparing to quarry the stone for the bridge across the Bonnechere River."

NEW YORK & CHICAGO SHORT LINE.—This company has been chartered in Chicago. Its purpose is to build a four-track railway from New York City to Chicago, Ill. The capital stock is $100,000, to be increased to $75,000,000 "as necessity requires." The incorporators are John Jay McKelvey, of New York City; Henry T. Huntington, Charles A. Judson and W. V. Latham, of Sandusky, O. This is probably a portion of the great line from New York to San Francisco, which has been agitating the rural press along its proposed route for some months.

Projects and Surveys.

BINGHAMTON & STATE LINE.—The surveys for this line from Binghamton, N. Y., to the Pennsylvania state line, have been completed. The line is 13½ miles long. A meeting of the directors will soon be held to let the contract for construction. It is stated by the local papers that the road will be built by a local capitalist, who will complete it within a year. Pres., Jos. P. Noyes, Binghampton, N. Y. Loc. Engr., Chas. W. Sherman, Binghamton, N. Y.

CATSKILL MOUNTAIN.—A press dispatch from Kingston, N. Y., says: "It is asserted that a new railway leading up into the Catskills from the main line of the West Shore at West Saugerties is soon to be built. George Harding, of the Kaaterskill House is said to be the leading spirit in the project. From New York to the Kaaterskill in three hours without change, is said to be his aim. After reaching the base of Mt. Lincoln the line of road creeps slowly up the grade on the north slope of that massive crag, with the great Kaaterskill canon on the right. It passes through Santa Cruz and Twilight parks. The upper terminus is reached near the Laurel House at Kaaterskill Falls. The ascent from the West Shore road is a little over 2,000 ft."

BELDEN POINT.—Chartered in New York to be operated by steam, electricity or other power, from the line of the New York, New Haven & Hartford R. R., in Westchester Co., between Westchester and Barton, to City Island. Among the directors are John G. Hyatt, Jas. English and W. W. Broodwell, of New York City, and Wm. Belden, of City Island, N. Y.

Southern.—Existing Roads.

SOUTH FLORIDA.—The contract for building the extension from Inverness via Dunnellon to High Springs, Fla., has been let to Morgan, Reynolds & Walker. The survey has been made, and a part of the rails are on the ground. Work has not been begun yet, but it is expected to begin soon.

BALTIMORE & OHIO.—The grading on the Fairmount, Morgantown & Pittsburg R. R., from Morgantown, W. Va., to Uniontown, Pa., 33 miles, will be practically completed by Nov. 1.

JACKSONVILLE, ST. AUGUSTINE & HALIFAX RIVER.—Tracklaying is now in progress from New Smyrna toward Rock Ledge, Fla., at the rate of one mile per day. Grading is practically completed from Daytona, Fla., to Rock Ledge, 85 miles.

Projects and Surveys.

HAINES CITY & GULF OF MEXICO.—A company is being organized by O. M. Crosby, of Avon Park, Fla.; W. W. Davis, of Midland, Fla.; and C. H. Smith, of Jacksonville, Fla., and others, to build a railway from Haines City, Fla., south via Crooked Lake, Midland, Pabor Lake, to Avon Park, and thence south via Fort Myers to some deep-water point on the Gulf of Mexico, with branches to Bartow and Arcadia.

PORTSMOUTH BELT.—Surveys are in progress for a railway connecting the Norfolk & Western R. R. with the Seaboard & Roanoke R. R., and the Richmond & Danville R. R., at Porthmouth, Va. The line will be about five miles long. Pres., J. H. Dingee, 333 Walnut St., Philadelphia, Pa.

Northwest.—Existing Roads.

CHICAGO, ROCK ISLAND & PACIFIC.—As noted last week, the contracts have all been let for the extension from Lincoln to Jansen, Neb., about 50 miles. About 500 men are now at work, and the line is to be opened for traffic in 1893.

MILWAUKEE, LAKE SHORE & WESTERN.—This company will build a depot to cost $15,000 at Manitowoc, Wis.

GREAT NORTHERN.—It is announced that grading will soon begin on the 9-mile extension from Park Rapids to Leech Lake, Minn., surveys for which were recently completed.

Projects and Surveys.

SIOUX CITY, CHICAGO & BALTIMORE.—Press dispatches from Sioux City, Ia., state that 10 miles of this line from Sioux City, Ia., southeast, will be built this fall. It is also stated that early in the spring work will be begun upon an additional 30 miles of the line.

Southwest.—Existing Roads.

ILLINOIS CENTRAL.—Surveys have been commenced for a branch from Tangipahoa, a rich timber section of the state.

SOUTHERN PACIFIC.—Tracklaying has been begun on the branch from New Iberia to Abbeville, La., 16¼ miles.

SOUTHERN PACIFIC.—A press dispatch from San Antonio, Tex., dated Oct. 2, says: "A dispatch was received here to-day from Monterey, Mexico, stating that representatives of the Southern Pacific Co are now in that city, and a survey will immediately be made of a proposed railway from Monterey to Portland, Tex., where it will connect with the San Antonio & Arkansas Pass R. R., which is now the property of the Southern Pacific. Such a road would be a direct seaport route to Monterey, and would shorten the time from New York to the City of Mexico by fully 200 miles. It will run through some rich mineral districts in Mexico."

KANSAS CITY, WATKINS & GULF.—It is stated that this company will begin work on the extension of its road from Lake Charles, La., to the Gulf of Mexico, this fall. Ch. Engr., P. H. Philbrick, Lake Charles, La.

Projects and Surveys.

ARKANSAS MINERAL BELT.—Chartered in Arkansas to build a railway from Little Rock, Ark., north to West Plains, Howell Co., Mo., 185 miles, of which 150 miles are in Arkansas. Pres., C. P. Huntington, New York City; First Vice-Pres., J. R. Moore, Heber, Ark.; Second Vice-Pres., W. H. Toothacker, Heber, Ark.; and Secy., W. L. Thompson, Heber, Ark.

Rocky Mt. and Pacific.—Existing Roads.

COLORADO MIDLAND.—About 125 men are now at work on the Cripple Creek line, from Divide to Midland, Colo. The line will be broad gage as far as Midland, which is about six miles from Cripple Creek, and from this point narrow gage lines will be built to the various mines. The contract for the terminals at Midland has been let to Price & McGavock. They will cost about $350,000.

SHELTON SOUTHWESTERN.—Articles of incorporation of this company were filed with the County Auditor, at Shelton, Wash., on Sept. 2. The incorporators are Allen C. Mason, Anthony Hayward, Stewart Rice, and John Snyder, Tacoma, and H. K. Tremper and E. S. Crowell, of Shelton. The capital stock is $2,000,000. The new company is formed to operate the Mason County Central R. R. The new company also absorbs all the interests of Allen C. Mason, in Mason Co., including the railroad, the Shelton sawmill, timber lands etc. The change is mainly a reorganization of the company to place the business in shape to extend the road. Bids for grading the new road have been asked, but work may not commence before spring.

COOS BAY, ROSEBURG & EASTERN.—It is stated that arrangements will soon be made to resume work on this Oregon railway. It is projected to run from Marshfield to Roseburg, Ore., 97 miles. Ten miles from Marshfield to Durhams were completed last year, and ten miles of grading were completed south of Durhams. Secy., W. E. Baines, Marshfield, Ore.

GREAT NORTHERN.—A press dispatch says: "Shepard, Seims & Co., of St. Paul, Minn., who have the contract for building the Pacific extension of the Great Northern Ry. to the summit of the Cascades, report abou 140 miles of track laid west of Spokane. The grading beyond that point is well under way, and will be finished by Nov. 1. It will require about thirty days' work to lay the track after that time, but on account of the delays in constructing bridges it will probably be the middle of December before the tracklaying is completed. Pending the construction of the steel bridge across the Columbia River, transfer boats will be used. A large force of men are working east from Puget Sound to the Cascades. Every effort is being made to have all the track completed before the first of the year, and unless unforeseen obstacles are encountered, this will be accomplished."

Projects and Surveys.

SAN FRANCISCO & CLEAR LAKE.—Chartered in California to build a railway from some point on the bay of San Francisco or San Pablo, to the northern part of Lake Co. Among the incorporators are: J. C. Brodhurst, J. W. Eisenhuth, E. M. Green and others.

BUTTE, ANACONDA & PACIFIC.—In a recent interview, Marcus Daly, who is at the head of this enterprise, stated that the line between Butte and Anaconda, Mont., would be built at once. The line will be entirely independent of any other road, but will be used by all of the lines entering Butte. It will probably be double tracked. Offices will be opened at Anaconda, Mont., at once, and preparations made to build the road.

WEISER & NORTHERN.—The route of this road, noted in our issue of Sept. 8, will be from Weiser, Idaho, up the Weiser River to Middle Valley, and thence to Salubria and Council Valley, and via Hornet Creek to the Seven Devils' Mines. Surveys have been completed as far as Council Valley, 58 miles. Pres., T. C. Galloway, Weiser, Idaho.

Foreign.

MEXICAN INTERNATIONAL.—All but 12 miles of track have been laid on the extension from Torreon to Durango, Mex., and the grading is entirely finished.

MEXICO CUERNAVACA & PACIFIC.—Work has begun on the preliminary survey from Jojutla to the Pacific Coast. Ch. Engr., John B. Butman, City of Mexico.; Pres., Geo. Tritch, 11 Bank Block, Denver, Colo.

NATIONAL OF TEHAUNTEPEC.—Mr. E. L. Corthell, one of the concessionaires, writes us that the press dispatch concerning this road, quoted in our issue of Sept. 1, is entirely erroneous. The road is owned by the Mexican Government, and the title in English is the National Railway of Tehuantepec. It is 190 miles long, extending from the mouth of the Coatzacoalcos River, on the north to Salina Cruz, on the Pacific Ocean. The concession for completing the work was given last spring by the Mexican Government, and work was begun in March, and has been actively prosecuted up to the present time with a large force. The track is laid for about 72 miles on the north side, and on the south side the track is laid about 47 miles, leaving about 71 miles of track to lay. The line between the ends of the track has been located, and work is under way nearly the entire distance. It is expected that the rails will be joined across the Isthmus by June of next year. The maximum grade, and that only for comparatively short distances, on the Pacific slope is 2%. There is no curvature over 10°. The iron bridges are not of any considerable length. There are several iron trestles on the south side of from 60 to 75 ft. in height, and one tunnel of about 300 ft., which is completed, and lined with brick. The money that is now being expended is the residue of the proceeds of £2,700,000 of government bonds. The amount remaining is expected to be enough to complete the railway as far as uniting the tracks. The road is fairly equipped; locomotives being American, English and Belgian. The cars are American and English. The rails are 56 lbs. to the yard, mostly English rails. The concessionaires are Chaudos S. Stanhope, San Juan de Letran, No. 13, City of Mexico; J. H. Hampson, same address, and E. L. Corthell, "The Temple," Chicago.

ELECTRIC RAILWAYS.

PROVIDENCE, R. I.—The Interstate Street Ry. Co. has presented a petition for the extension of the trolley system from Exchange Place to Roger Williams Park and Field's Point, and the Union Ry. Co. has asked for the general substitution of the trolley system over its routes throughout the city. Both have been referred to the Committee on Railways. A bill has been passed authorizing the Union Ry. Co. to operate the Pawtucket route by the overhead trolley system.

NEW YORK, N. Y.—The Belden Point Ry. Co. has been organized to build a line from the New York, New Haven & Hartford R. R., at a point between Westchester and Bartow, to City Island. Capital stock, $30,000. Among the directors are John G. Hyatt, P. D. Sturgis and Andrew Mitchell, of New York, and Wm. Belden, of City Island.—The aldermen have passed the bill granting extensive privileges to the Metropolitan Traction Co., including the use of the overhead trolley wire system, but the Mayor has not yet signed the bill.

BROOKLYN, N Y.—The Brooklyn City Ry. Co. will build a power house at a cost of $500,000. The new track, consisting of girder rails on iron chairs on wooden cross-ties, is now being laid on lower Fulton St.

NIAGARA FALLS, N. Y.—A company proposes to build a line to La Salle, and is negotiating with property owners along the route.

PATERSON, N. J.—Passaic, Rutherford & Carlstadt Electric Ry. Co.; $185,000; J. A. Morrisse, F. C. Van Dyke and A. H. Post, of Paterson, and J. V. Morrisse, of Passaic.—Paterson & Passaic Electric Ry. Co.; $40,000; J. A. Morrisse and A. H. Post, of Paterson, and C. H. Russell, of Brooklyn, N. Y.

HANOVER, PA.—Hanover & McSherrytown Street Ry. Co.; capital, $30,000; commencing with $7,500; Pres., John C. Tanger.

POTTSTOWN, PA.—People's Passenger Ry. Co.; capital, $75,000, commencing with $15,000; Pres., John P. Dunn.

BALTIMORE, MD.—An ordinance is under consideration authorizing the Edmondson Avenue, Catonsville & Ellicott City Electric Ry. Co. to build a railway in the western part of the city. The incorporators are John Glenn, Victor G. Bloede, Henry B. Whiteley, Carl Schon, of Baltimore County; and Dr. Henry J. Berkeley, Louis Yakel and George Yakel, of Baltimore. It is proposed to build from the Red Line car stables on West Baltimore St., to Catonsville and Ellicott City, by way of the Calverton Road, Edmondson Ave., the old Frederick Road, Nunnery Lane, Ingleside Ave. and Beaumont Ave., as far as Benzinger's Lane. The route thence to Ellicott City has not been determined, as it will cross private property. The line is to be eight miles long. Edmondson Ave. bridge over Gwynn's Falls will have to be raised 20 ft., or the hill must be cut down.—The City & Suburban Ry. is securing material for the York Road electric line.

JEFFERSON, ILL.—The Jefferson Street Ry. Co. has been organized, with a capital stock of $500,000. The route followed will be west of Elston Ave. from Western Ave. to Jefferson Ave., where a loop will be made and cars returned by the way of Lawrence Ave. to Elston Ave.

EUGENE, ORE.—A party of capitalists proposes to build an electric railway from Eugene to Springfield, and a meeting of the leading business men was held recently for the purpose of consultation, the object being to see what encouragement the project might have. The business men and the company came to favorable arrangements, and the road will probably be built.

KINGSTON, ONT.—The negotiations between the Kingston Street Ry. Co. and the City Council in respect to the introduction of electricity have been canceled. The company wanted a perpetual charter and the Council refused to grant the privilege. The Committee on Streets has been commissioned to negotiate for an electric car service on streets other than those occupied by the present company.

ELEVATED RAILWAYS.

BROOKLYN, N. Y.—The Kings County Elevated Ry will next year build the remaining 1¼ miles of structure to reach the city line. The plans for the connection with the Brooklyn & Brighton Beach R. R. have not yet been completed. The company will add 5 engines and 28 cars to its equipment, at a cost of $100,000.

PHILADELPHIA, PA.—The Quaker City Elevated Ry Co. has appointed Mr. Charles Buchholz, M. Am. Soc. C. E., President and Chief Engineer. Mr. Buchholz has for the last eight years been Chief Engineer of the New York, Lake Erie & Western R. R.

CHICAGO, ILL.—The Metropolitan Elevated Ry. Co. is rapidly acquiring right of way and is proceeding much more rapidly than the Chicago & South Side Elevated Ry. Co. was able to on the South Side. Much less opposition is encountered, and a large part of the purchases will be made without the intervention of condemnation proceedings. Herman Benzo is right of way agent.

HORSE AND MOTOR RAILWAYS.

NORWALK, CONN.—The Norwalk Tramway Co. has decided to build the entire length of the road at once. The material will be ordered shortly, and work pushed in order to have the road completed by January. The company has a capital stock of $30,000.

CAMDEN, N. J.—The North Shore Traction Co. has been incorporated to build and operate motors, cables and mechanical and electrical appliances for supplying motor power. The authorized capital stock is $600,000, and the company commences business with $2 000. E. E. Denniston and J. V. Ilsley, of Germantown, Pa.; C. F. Stevens, of Philadelphia, Pa.; S. E. Hass, Chester, Pa.; J. McNeil, Haddenfield, N. J.

NANTICOKE, PA.—People's Street Ry. Co.; to build a line to Newport; capital stock, $60,000; beginning business with $12,000; Pres., K. M. Smith.

HIGHWAYS.

NEW YORK.—The $36,000 road bonds of the town of Oyster Bay (L. I.) for macadamizing that portion of the Jericho road lying in the town, have been sold to the Jamaica Savings Bank, at 102.—The Newtown (L. I.) Highway Commissioners have issued proposals for the repair of Flushing Ave., from the boundary line to Old Train's Meadow road. Surveyor Moneikeim has made a profile of the proposed improvement, and submitted it to the Highway Commissioners. The work will begin immediately.

NEW JERSEY.—Proposals for constructing 3,080 ft. of road at West Cape May, will be received until Oct. 15, by S. Bardsley, Secy., Mount Vernon Land Co., 1223 Germantown Ave., Philadelphia, Pa. Specifications can be had on application.

KENTUCKY.—The Bowling Green and Three Springs turnpike is to be built by a stock company, and nearly the required amount of stock has been taken in Bowling Green. The county has nothing to do with this pike, and will own no stock in it. It is proposed to make it 18 ft. wide and well graveled. It will extend from Broadway three miles into the country, in the direction of Three Springs, and will have a toll-gate on it. The work will be started soon.

CALIFORNIA.—The County Surveyor of Santa Clara has been making a survey of a new alinement for the road between Gilroy and San Felipe, by way of Frazier Lake. The county officers are at San Jose.

WATER-WORKS.

New England.

AUBURN, ME.—Surveys for a new reservoir are being made for the company by Engr. Bowman.

WOLFBORO JUNCTION, N. H.—It is reported that preliminary surveys for works are being made.

NEW BRITAIN, CONN.—Mayor Walsh has been authorized to effect a temporary loan of $40,000, the money to be used in the construction of a new canal at Shuttle Meadow Lake.

Middle.

CHESTER, N. Y.—The time for receiving bids for the construction of works has been extended from Oct. 7 to Oct. 14. Plans and specifications can be seen at the office of the Board of Water Commissioners. Pres., Wm. A. Lawrence.

DAVENPORT, N. Y.—Works are about to be built by W. H. Cowan, Stamford, N. Y., it is reported.

FORT EDWARD, N. Y.—Engr. S. E. Babcock, Little Falls, N. Y., has recommended to the village a supply from three streams about two miles distant, with a reservoir and 20-in. supply main.

NEWTOWN, N. Y.—The Woodside Water Co. has been incorporated; $500,000; Directors, P. J. Gleason, Long Island City, Chas. Lynch, Detroit, Mich., Daniel Hickey, Laurel Hill, and others.

STONY POINT, N. Y.—The Stony Point Water Co. has been incorporated; $50,000.

ATLANTIC CITY, N. J.—It is stated that the Council has empowered its Water Committee to buy the property of the Consumers' Water Co., for $200,000 of 5% bonds.

ALLEGHENY, PA.—An issue of $1,000,000 of bonds for a new supply may be voted on in November. An informal meeting has been held to discuss a joint system for Allegheny and Pittsburg, with a supply from Indian Creek, at an estimated cost of $17,000,000.

ERIE, PA.—It is reported that the city has contracted for a 12,000,000-gallon Worthington pump at $46,300. A Gaskill pump was offered for $49,500 and a Blake for $42,356. It is said that the piston speed of the Blake, as proposed, was considered too high.

HUNTINGDON, PA.—A second system is talked of. It is reported that John White and C. C. Read have bought Snack's Spring on Jack's Mt., about seven miles distant, and that a survey has been made by Engr. J. Murray Africa.

MONTOURSVILLE, PA.—The contract for furnishing and laying pipe for the new works has been awarded to J. Herdic, Williamsport, for $14,728. The sum of $17,265 is available for works.

PHILADELPHIA, PA.—The Common Council has passed an ordinance authorizing the Department of Public Works to contract for a reservoir in the 28th Ward at a cost not over $1,000,000.

Southern.

KEYSER, W. VA.—Works are projected.

ATHENS, GA.—Sept. 30 the people voted $125,000 for works. The Athens Water Co., which built works here in 1883, has reorganized as the New York Water Co., Ltd., as a foreign corporation. The company claims that the city is under contract with it for water and cannot build works.

HARRIMAN, TENN.—It is stated that plans and estimates for works have been submitted by J. T. Lakin, Chicago, representing the Holly Mfg. Co., Lockport, N. Y.

North Central.

NORWOOD, O.—Nov. 8 the people will vote on issuing $50,000 bonds, bearing not over 5½% interest, for works. An artesian well is proposed as a source of supply.

CROWN POINT, IND.—It is stated that works "are a sure go."

MIDDLEBURY, IND.—There is talk of organizing a water company.

ROCHESTER, IND.—The Rochester Water-Works Co. has been incorporated; $45,000.

CANTON, ILL.—A better water supply is talked of.

CENTRALIA, ILL.—Plans and specifications for a system of water-works are being prepared by Isaac A. Smith, M. Am. Soc. C. E., of St. Louis, Mo.

MARENGO, ILL.—Works are being discussed.

BERLIN, WIS.—Works are projected.

Northwestern.

NIOBRARA, NEB.—Oct. 17 the people will vote on issuing $4,000 of bonds for works. The July election was illegal.

Southwestern.

GORDON, TEX.—The construction of works has been started.

ANTONITO, COLO.—Two propositions for works are under consideration.

CRIPPLE CREEK, COLO.—J. A Jones, representing the Michigan Pipe Co., Bay City, Mich., has applied to the Tremont Town Board for a franchise allowing him to introduce water from the McCree Spring.

Pacific.

BUCKLEY, WASH.—Bids for building works are wanted until Oct. 11 by Chas. E. Taylor, Town Clk. There will be a supply well, pumping plant, tower and tank; also 6,500 ft. 6-in., 2,000 ft. 4-in., 4,000 ft. 3-in. wrought iron pipe; 6 6-in., 5 4-in., and 8 3-in. gates; 6 double nozzle hydrants and 76 pieces specials. Engrs. W. P. & A. B. Wood, Tacoma, Wash.

PROSSER FALLS, WASH.—The Prosser Falls Land Co. has been incorporated to operate electric light and water works, improve real estate, etc.; $100,000.

SPOKANE, WASH.—The city has at last bought what is known as the Clark site for a water power pumping station, paying $80,000.

OREGON.—It is reported that Harrisburg has contracted for works, and that plans have been ordered made for works at Oakland and Corvallis. A company built works in Corvallis in 1887.

CALIFORNIA.—The Sierra Water & Power Co. has been incorporated to supply water for domestic and irrigation purposes as noted below under "Irrigation."

WATSONVILLE, CAL.—A special election will probably be held to vote on issuing $450,000 of bonds to buy the water and electric lighting plants.

LOGAN, UTAH.—Bonds to the amount of $40,000 are proposed for new works.

IRRIGATION.

NEW COMPANIES.—American Land & Irrigating Canal Co.; Denver, Colo.; Directors, John G. Montgomery, J. H. Leary, and others; to buy land, irrigation works, etc., and construct new works in Colorado, Wyoming, Montana, Idaho, New Mexico and Utah. Sierra Water & Power Co., $200,000; Directors, Geo. A. Haskell, Los Angeles, Cal., H. C. and J. W. Oakley, Ontario, A. J. & F. S. Wallace, Pasadena; to furnish electric power, water for domestic and irrigation purposes to Rialto, Chino, Etiwando, Cucamonga, and Ontario. Summit Lake Water Co., San Francisco, Cal., $3,000,000; Directors, T. J. Parsons, O. W. Forsyth and others.

BRIDGES, TUNNELS AND CANALS.

WORCESTER, MASS.—There is talk of building a bridge 180 ft. long over the New York, New Haven & Hartford R. R. Co.'s tracks at Elm St. The bridge will cost about $30,000 and will be built at the joint expense of the township and the railway company.

McKEESPORT, PA.—The East End Bridge Co., of McKeesport, Pa., has been chartered in Pennsylvania. E. J. Taylor, McKeesport, Pa., John W. Crawford, Duquesne, Pa.

ST. CLOUD, MINN.—The City Councils have voted to build a steel highway bridge over the Mississippi River at this place.

OMAHA, NEB.—The Omaha Bridge & Ry. Terminal Co., is reported to have secured the money necessary to build its proposed bridge over the Missouri River, between Omaha, Neb., and Council Bluffs, Ia. The bridge will cost about $1,000,000, and work is to begin at once.

ST. LOUIS, MO.—The Street Department is considering the construction of a bridge over the Union Depot site, on Clark Ave., to cost about $150,000.

HELENA, MONT.—Bids will be received until Oct. 20 for building a 180-ft. span "iron combination bridge" over Dearborn River, J. S. Tooker, Co. Clerk, Helena, Mont.

SEWERS.

LITTLETON, N. H.—Plans and estimates for a system of sewerage are being prepared by Geo. H. Allen, Manchester. The town has already built about 1,000 ft. of sewers, and it is expected that next year the work will be extended according to plans now being prepared.

MONTPELIER, VT.—An engineer has prepared a report on a sewerage system for the village, and a public meeting will soon be held to consider the question.

BOSTON, MASS.—About 20 sewers are being constructed in different sections of the city, all but eight being done by day labor. Soundings are now being made along Charles River at the rear of Beacon St. preparatory to putting in a sewer to connect with the main trunk sewer. The Metropolitan Sewerage Commissioners will receive bids until Oct. 22 for section 28 of the main sewer, in Cambridge. See advertisement.

PLYMOUTH, MASS.—A public meeting was held Oct. 5 to discuss the sewerage problem. At a meeting Sept. 28 it was voted that the town ought to adopt a sewerage system.

PROVIDENCE, R. I.—The Commissioner of Public Works reports as follows concerning the resolution approved July 15, 1889, ordering him to contract for the materials and construction of an improved sewerage system. The cost of sewers completed and under construction Aug. 31, 1892, was $1,007,737; estimated cost to complete sewers now under construction is about $149,900; sewer in Canal St., ordered but not commenced, is estimated to cost about $13,900; estimated cost of sewers in other streets being laid out for the improved sewerage system, about $97,800; total, $1,269,337. The approximate estimate of the cost of the balance of the work, not included in preceding, is $1,927,600.

COHOES, N. Y.—The council will receive bids at the meeting Oct. 19 for a 12 and 18-in. sewer in one street.

FLUSHING, N. Y.—The Village Trustees have voted to construct a sewer in Myrtle Ave. The work is estimated to cost about $25.000 and has been under consideration for a long time.

FORT PLAIN, N. Y.—D. C. Smith, Schenectady, has been engaged to prepare plans and estimates for a system of sewerage for this village. It is thought that the cost of the system will be less than $25,000.

NEW YORK, N. Y.—The following bids have been received for a sewer in Jerome Ave. from the Harlem River to Elliott St.: Jones & Brosnan, $193,598; John McQuade, $222,930; Bernard McMahon, $228,245. The lowest bid for a sewer in East 173d St. was that of Wm. N. Myers, $6,820. Bids are asked until Oct. 18 for seven sewers.

NIAGARA FALLS, N. Y.—Bids are asked until Oct. 28 for a trunk sewer, consisting of an 8-ft. tunnel about 5,000 ft. long and 45 ft. below the surface. E. Z. Burns, Cy. Engr. See advertisement.

MCKEESPORT, PA.—Several contracts were awarded Sept. 26, the largest being to Keeling, Ridge & Co., at $9,773.

MEADVILLE, PA.—At a joint session of the councils Sept. 26 a resolution was adopted to employ an expert

sanitary engineer to prepare plans and estimates for a complete system of sewerage.

SCRANTON, PA.—The question of a sewerage system in South Scranton is being discussed. The City Engineer has prepared plans for a system estimated to cost about $77,000.

ANACOSTIA, D. C.—The need of sewers is being brought to the attention of the Commissioners by the Citizens' Association.

MANCHESTER, VA.—It is reported that the Street Committee will soon advertise for bids for a system of sewers.

CHARLESTON, S. C.—The necessity of additional sewers is being urged.

LAREDO, TEX.—The estimated cost of a system of storm water sewers is $40,000.

CLEVELAND, O.—The Board of Control will receive bids until Oct. 13 for sewers in two streets.

GALION, O.—We are informed by H. W. McDonald & Son that the bids for a sewer system in North Galion have been rejected, and that the work will be done by day labor.

YOUNGSTOWN, O.—The City Clerk will receive bids until Oct. 21 for a sewer in districts 4 and 5.

JOLIET, ILL.—The contract for a sewer in Cass St. has been awarded to Frank Murphy at $6,320.

FARGO, N. DAK.—The City Auditor will receive bids until Nov. 7 for about a mile of sewers.

FRESNO, CAL.—The City Engineer has been directed to prepare estimates for the completion of the sewer system. It is proposed to call a special election to vote on the issue of bonds for $50,000 for this purpose.

LOS ANGELES, CAL.—The Council has voted to advertise for bids for 12,000 bbls. of cement for the outfall sewer.

PORTLAND, ORE.—The contract for the East Side sewer has been awarded to Wilson & Ryan at $116,513.

SEATTLE, WASH.—The Board of Public Works will receive bids until Oct. 24 for 3,000 casks of Portland cement to be used in the lining of the Lake Union sewer tunnel.

NEGAUNEE, MICH.—Bids are asked until Oct. 15 for 15,850 cu. ft. of 15 to 24-in. pipe sewers. C. R. Wightman, Engr. in Charge. See advertisement.

STREETS.

BOSTON, MASS.—The Board of Aldermen has passed an order requesting the Street Commissioners to ascertain and report at the next meeting the estimated cost of widening Washington St. to a width of 60 ft. from Spring Lane to Milk St., passing under the tower of the Old South Church by an arcade, if deemed advisable. The City auditor has been authorized to transfer the sum of $75,000 from the appropriation for Causeway St. extension to an appropriation for the widening and extending of Chambers St. from Ashland to Livingston St.

BROOKLINE, MASS.—The contract for macadamizing and paving the Cypress St. bridge has been awarded to T. J. Kelley at $6,765.

ELMIRA, N. Y.—The Common Council has voted to pave two streets with vitrified brick.

NEW YORK, N. Y.—The contract for grading, etc., Union Ave., from the Southern Boulevard to 156th St. has been awarded to Wm. F. Murray at $37,683. Bids are asked until Oct. 18 for four contracts.

ROCHESTER, N. Y.—The contract for building the park boulevard from Lake Ave. to the railroad has been awarded to Geo Chambers at $7,317.

UTICA, N. Y.—A contract has been awarded to the Warren-Scharf Asphalt Paving Co. at about $150,000.

JERSEY CITY, N. J.—The City Engineer estimates the cost of the proposed opening of 17th St. to Hoboken Ave. as follows: 20,500 cu. yds. earth filling, $6,150; 9,760 ft. flagging, $1,561; 150 cu. yds. sand, $180; 2,440 ft. curbing, $1,464; total, $9,355.

PHILADELPHIA, PA.—The Council's Highway Committee has voted to present an ordinance for a loan of $1,000,000 for repaving streets not occupied by street railway companies.

ALLEGHENY, PA.—An ordinance is being prepared to submit to the people's vote the question of issuing bonds for $2,000,000 for various improvements, as follows: $1,000,000 for the extension of the water main up the river to Six Mile Island; $600,000 for street improvements; $300,000 for sewers; and $100,000 for lighting purposes.

CINCINNATI, O.—The Eden Avenue Improvement Society has been formed by citizens of Corryville, Avondale and Walnut Hills, to secure the improvement of Eden Ave. from Molitor St. to the Zoological Gardens. The estimated cost of the work is $79,000.

DANVILLE, ILL.—The City Engineer will receive bids until Oct. 26 for paving William St.

PEORIA, ILL.—The contract for paving South Washington St. with brick has been awarded to John Bassler, Galesburg, at about $26,000.

LOGANSPORT, IND.—The City Clerk will receive bids until Oct. 18 for the improvement of the unfinished portion of Spencer St.

MINNEAPOLIS, MINN.—Chas. O. Huntress, Asst. Cy. Engr., informs us that for several years all the sewer construction work has been done by the city by day labor, and that the paving work is generally taken care of by local contractors. The contract work in the line of curb, gutter and paving, amounted in the season of 1891, to about $240,000, and for 1892 to about $55,000.

OMAHA, NEB.—The Board of Public Works will receive bids until Oct. 14 for paving with asphalt, granite, sandstone or brick, and for constructing curb in one street; also for grading.

ELECTRICAL.

PEABODY, MASS.—The electric lighting plant has been completed. The entire town, except West Peabody, is lighted by 150 arc lights of 1,200 c. p. The plant cost $50,000, and consists of a brick power station, with a 125-ft. chimney, a 150-HP. engine, 2 125-HP. boilers, and 4 dynamos with a capacity of 194 arc lamps.

PROVIDENCE, R. I.—The City Council has approved the proposed new contract with the Narragansett Electric Light Co. for 1,300 arc lights, the price to be determined by the unanimous decision of the arbitrators selected. This contract will expire June 15, 1897.

SOUTH ORANGE, N. J.—The Village Trustees received the following bids for lighting the streets: Essex County Electric Co., $110 per lamp per year for 1,200-c. p. arc lights, and the Citizens' Gas Co., Newark, $29 per lamp per year for gas lights. At present the village is lighted by gas at $22 per lamp per year. The trustees propose to put in about 40 electric lights, and to reduce the number of gas lights to 200.

PARKERSBURG, W. VA.—The Parkersburg Electric Light Co. is reported about to increase the power of its plant, including the addition of a power plant.

BATON ROUGE, LA.—The Capital Railway & Lighting Co. has been chartered to purchase the plants of the Baton Rouge Street Ry. Co. and the Citizens' Electric Light & Power Co., both of which it is proposed to improve and enlarge; capital stock, $150,000; Pres., B. R. Mayer; Treas., W. J. Knox.

MATTOON, ILL.—The City Council is reported as receiving bids for 100 arc lights; Standard single carbon lamps to be used.

TURNER, ILL.—A franchise has been granted to the Turner Electric Light Co. Both arc and incandescent lights will be used.

KANSAS CITY, KAN.—The special committee appointed to investigate the proposition of the Fort Wayne Electric Supply Co. to build an electric light plant for the city has reported unanimously in favor of the project.

NEW COMPANIES.—Trenton Light & Power Co., Trenton, N. J.; $760,000; J. Moses and S. D. Greene, New York; F. A. Magowan and W. B. Allen, Trenton. Starr Electrical Co., New York, N. Y.; $1,000,000; to own and develop patents granted to J. H. Mason; Jas. B. McNab, Oliver Duncan, F. B. Hoofer. Electric Light & Power Co., Syracuse, N. Y.; $800,000; E. J. Garfield, M. C. Manning, R. E. Drake. Columbia Heights Electric Co., Columbia Heights, Ill.; $25,000; J. F. Keeney, C. D. Otis, I. N. Rice.

CONTRACT PRICES.

JETTY WORK.—Charleston, S. C.—Capt. F. V. Abbott has opened bids for the completion of the work on the jetties in Charleston harbor. The amount of work to be done is as follows:

1. 10,000 tons of stone for shore ends.
2. 150,000 tons of stone to widen 7,000 ft., both jetties.
3. 40,000 tons to raise inner 7,000 ft., both jetties.
4. 40,000 tons to reinforce high parts.
5. 100,000 tons to raise outer ends.
6. 40,000 sq. yds. mattress.
7. 50,000 tons for ballast.
8. 100,000 tons stone.
9. 2,000,000 cu. yds. material dredged.

The bids were as follows:

Bidders.	(1) $	(2) $	(3) $
E. H. Gaynor, Boston, Mass.....	3.00	2.65	2.75
Colin McK. Grant, Charleston....	2.61	2.36	2.41
Egan & Friday, Columbia.....	3.20	2.25	2.30
Henry Oliver, Charleston.....	2.85	2.60	2.83
Alabama Dredging & Jetty Co., Mobile, Ala.....	3.50	2.55	2.65
H. W. & E. P. Crouch, Charleston.	2.75	2.75	2.75

(4) $	(5) $	(6) $	(7) $	(8) $	(9) $	Total. $
2.75	2.75	1.50	2.70	2.85	.40	2,367,500
2.38	2.33	1.07	2.45	2.50	.31	1,983,800
2.30	2.30	1.25	2.35	2.35	.28	1,884,000
2.85	2.85	1.25	2.60	2.85	.50	2,567,500
2.65	2.65	1.48	2.55	2.70	.34½	2,200,000
2.75	2.80	.75	2.75	2.90	.30	2,162,500

SHIP CHANNEL.—Mobile, Ala.—Bids were opened Sept. 28 for completing the ship channel between Mobile and deep water in Mobile Bay. The present depth of the work is 20 ft. and the width 180 ft., and the bids are on a basis of a depth of 23 ft. and width of 280 ft. The appropriation for this year is $212,000 and the contract calls for an expenditure of $1,393,800. The bids were as follows: National Dredging Co., Wilmington, Del., 7 7-10 cts. per cu. yd.; Alabama Dredging & Jetty Co., Mobile, 9 cts.; Leopold Marx, Mobile, 9¼ cts.; Leonard Walsh & Co., Mobile, 10½ cts.; American Dredging Co., Philadelphia, Pa., 71 cts. The Alabama Dredging & Jetty Co. bid 18 cts. per cu. yd. for the improvement of Pascagoula River and harbor, and of Biloxi (Miss.) harbor.

DAMS AND SHORE PROTECTIONS.—Rock Island, Ill.—Maj. A. Mackenzie has opened bids for the construction of dams and shore protections on the Mississippi River. Three contracts each call for 25,000 cu. yds. of rock and the same quantity of brush in place, and one contract for 22,500 cu. yds. of each. The bids ranged from $1.38 to $1.53 per cu. yd. for rock, and from 54 to 75 cts. per cu. yd. for brush.

MISCELLANEOUS.

DREDGING.—Superior, Wis.—The Board of Public Works will receive bids until Oct. 10 and 11 for dredging about 597,000 cu. yds. See advertisement.

STONE CAPPINGS.—Washington, D. C.—The Treasury Department has rejected all bids received for furnishing stone cappings as foundations for the walls of the new city post office. The bids averaged about $120,000 and antedated the eight-hour law. The work will soon be readvertised.

DRY DOCK.—Washington, D. C.—The contract for a dry dock at the Puget Sound naval station has been awarded to Byron, Barlow & Co., Tacoma, Wash., at $491,465. The proposed dry dock was described and illustrated in our issue of May 19.

STREET WORK.—Harrisburg, Pa.—The contract for paving Sixth St. with asphalt has been awarded to the Barber Asphalt Paving Co., at $2.75 per sq. yd. for paving and 75 cts. per lin. ft. for blue stone curbing. There will be about 16,068 sq. yds. of paving and 5,900 lin. ft. of curbing, and the work is guaranteed for five years.

Chattanooga, Tenn.—Three contracts, aggregating about 10,800 sq. yds., have been awarded to the Southern Construction Co. as follows: Paving with brick, $2.29 per sq. yd.; old curb reset, 10 cts. per lin. ft.; old curb redressed, 15 cts.; new circular curb, $1.

STONE.—Davenport, Ont.—Bids will be received until Oct. 13 for 230 toise of stone suitable for breaking into road macadam. Bids may be for lots of ten toise or more, each toise to contain 206 cu. ft. G. B. Abrey, Town Engr.

CULVERT, REMOVING OBSTRUCTIONS, ETC.—Albany, N. Y.—The Superintendent of Public Works will receive bids until Oct. 17 for constructing an iron-pipe culvert under the Erie Canal at Corley's Basin, in the town of Sweden; for removing the obstructions from the prison of the Erie Canal in the city of Buffalo, and for strengthening and protecting the berm bank of the Erie Canal near the city of Schenectady.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, Pa., have an order for 10 compound consolidation engines for the Lehigh Valley, and have built 10 fast passenger engines, with cylinders 20×24 ins., and driving wheels 6 ft. 6 ins. diameter, for the Baltimore & Ohio, and 10 ten-wheel engines for the Missouri Pacific. The Richmond Locomotive Works, Richmond, Va., have delivered 5 eight-wheel engines to the Savannah, Americus & Montgomery. The Brooks Locomotive Works, Dunkirk, N. Y., have an order for 3 freight engines for the Peoria & Pekin Union. The Grant Locomotive works, Chicago, Ill., are building 5 switch engines, with cylinders 16×22 ins., for the Chicago, Milwaukee & St. Paul, and 5 ten-wheel engines, with cylinders 18×26 ins., for stock.

CARS.—The Crossen Car Mfg. Co., Coburg, Ont., is building 12 sleeping cars for the Canadian Pacific, and has built a dining car for the same road; the company is building passenger, freight and street cars. The South Baltimore Car Co., South Baltimore, Md., has an order for 350 coal and flat cars for the West Virginia & Pittsburg. The Mount Vernon Car Co., Mount Vernon, O., has an order for 100 box cars for the Illinois Central. The Buffalo Car Mfg. Co., Buffalo, N. Y., is building 100 furniture cars for the New York Central. The Ohio Falls Car Co., Jeffersonville, Ind., is building 40 cars for the Live Poultry Transportation Co. The Ensign Car & Mfg. Co., Huntington, W. Va., has added considerable new machinery to its plant, and has orders on hand for 50 fruit cars and 50 refrigerator cars. It is reported that the Lima Car Works, Lima, O., were destroyed by fire Sept. 28.

DUMP CARS.—About 16 second-hand side dump cars of 2 or 3 cu. yds. capacity are wanted by John G. Adams, Box 111, Richmond, Va.

ELECTRIC CARS.—The West End Sreet Ry. Co., of Boston, Mass., finding the 15-HP. motor too small for its long cars, and having, in consequence of the substitution of long for short cars, a surplus of cars, offers for sale several open and box cars, with and without electrical equipment, and also car trucks.

TRACKLAYING MACHINES.—The Wabash Ry. has made a contract with D. F. Holman, 94 Dearborn St., Chicago, to operate two of his tracklaying machines on the Detroit extension.

SIGNALS.—It is reported that George O. Williver and J. M. R. Shimer, of Phillipsburg, N. J., and Dr. G. C. Young, of Washington, have secured a patent for a new railway block signal, and will form a company with a capital stock of $600,000. A party of Philadelphia capitalists is said to have agreed to take all the stock.

PUMPING ENGINE.—The firm of Henry R. Worthington, New York, has an order for a pumping engine of 1,500,000 gals. daily capacity for the Schenectady Locomotive Works, Schenectady, N. Y.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., is building the new machine shop for the Mather Electric Co., South Manchester, Conn. The building is 52×150 ft., the central portion being 35 ft. in width and controlled by a 15-ton traveling crane. The design is a combination of iron and wood, all the heavier parts of the building being of iron.

TAYLOR, GOODHUE & AMES, Monadnock Building, Chicago, is a new firm in the electrical supply business, and will manufacture and deal in material for light and power plant. Pres., Wm. Taylor; Vice-Pres., Wells Goodhue; Secy., H. D. Ames.

NEW COMPANIES.—Acme Paving Co., Chicago, Ill.; $10,000; W. H. Baker, W. D. Washburn and Wm. Brace. Economy Down-Draft Boiler Co., Chicago, Ill., $125,000; C. Cleveland, T. Johnson and Thomas Cratty. Reversible Brake Beam Co., East St. Louis, Ill.; $1,000,000; Dennis P. Slattery, C. F. Ziebold and Legrand Cannon. Clark Car Coupler Co., Chicago, Ill.; $500,000; W. B. Clark, Frank Brakeman and G. B. Treloar. Safety Building & Construction Co., Chicago, Ill.; $1,000,000; Mark Werler, George E. Williams, W. S. Taylor. East Chicago Iron & Steel Co., Chicago, Ill.; $250,000; H. E. Weaver, Josiah J. Parkhurst and W. Vincent Baker.

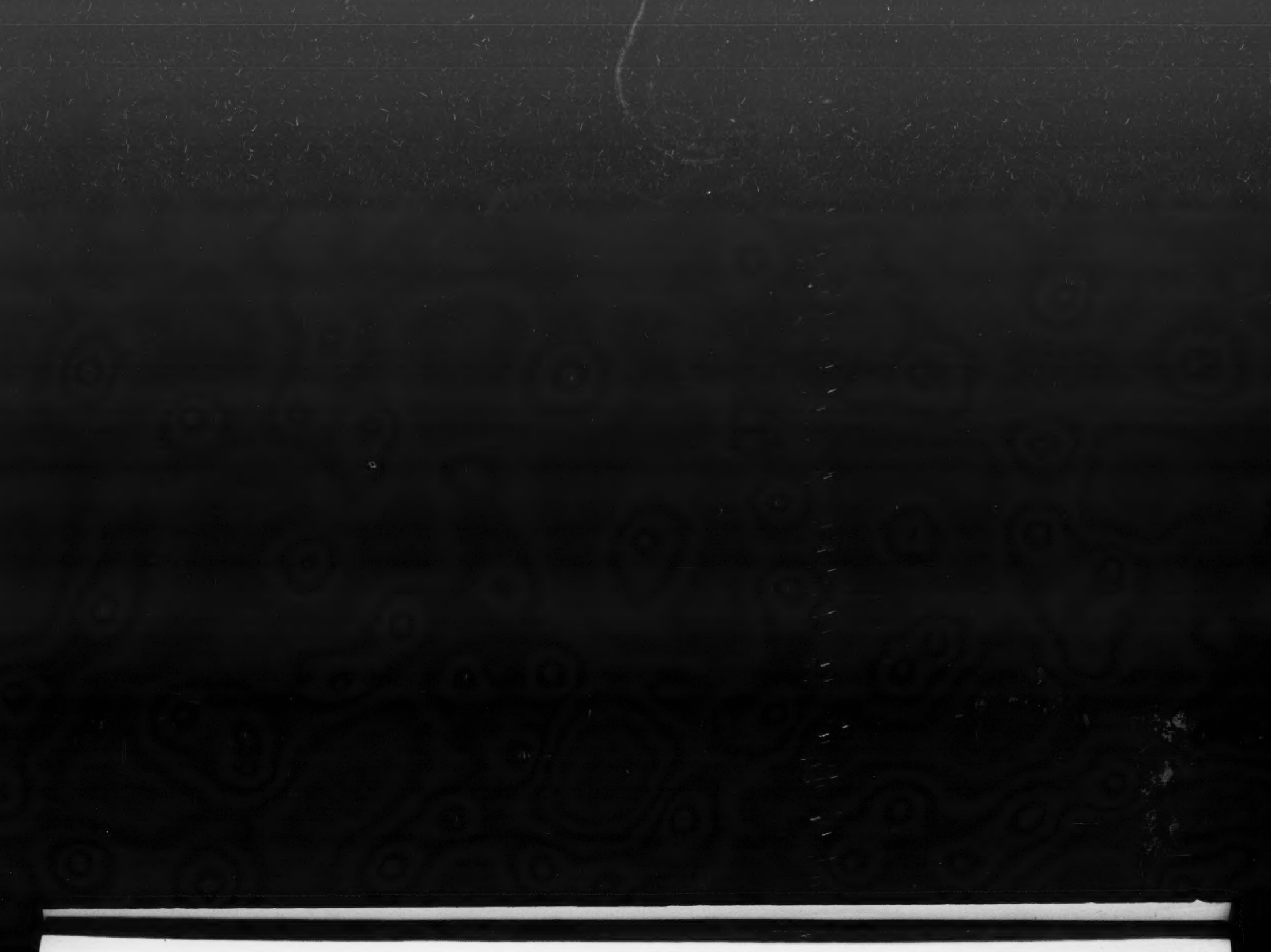
CURRENT PRICES.

RAILS.—New York: $30 at eastern mills, $30.75 at tidewater; old rails, $16.50 to $17 for iron and $14 to $14.50 for steel. Pittsburg: $30; old rails, $19 to $20 for iron and $15 to $16 for steel. Chicago: $31 to $32.50; light rails, $32; old rails, $17.50 to $19 for iron and $12.50 to $14.25 for steel.

TRACK MATERIAL.—New York: steel angle bars, 1.6 to 1.65 cts.; spikes, 1.9 to 2 cts.; track bolts, 2.4 to 2.6 cts. with square and 2.7 to 2.8 cts. with hexagon nuts. Pittsburg: splice bars, 1.75 to 1.77 cts. for iron and 1.8 cts. for steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.7 cts. with square and 2.8 cts. with hexagon nuts. Chicago: splice bars, 1.7 to 1.75 cts. for iron and steel; spikes, 2.1 to 2.15 cts.; track bolts, 2.6 to 2.7 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows at Pittsburg: 60 and 10% and 50 and 10% on black and galvanized butt-welded; 70% and 60% on black and galvanized lap-welded. Casing, 55%.

FOUNDRY PIG IRON.—New York: $14 to $15.50. Pittsburg: $13 to $14.25. Chicago: $13.25 to $14.75.

LEAD.—New York: 4.05 to 4.07 cts.; Chicago: 3.9 to 3.95 cts.; St. Louis: 3.8 to 3.85 cts

STRUCTURAL MATERIAL.—New York: beams, 2.2 to 2.5 cts. for large lots, and 2.35 to 2.75 cts. for small lots; channels, 2.25 to 2.5 cts.; angles, 1.95 to 2 cts.; tees, 2.3 to 2.75 cts.; sheared iron plates, 1.85 to 2.1 cts.; steel plates, 1.9 to 2 cts. for tank, 2.2 to 2.25 cts. for shell, 2.5 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 2 to 2.05 cts.; channels, 2 to 2.05 cts.; angles, 1.85 to 1.95 cts.; tees, 2.4 to 2.5 cts.; Z-bars, 2.1 to 2.15 cts.; universal mill plates, 1.8 to 1.85 cts. for steel; sheared steel bridge plates, 2 to 2.1 cts.; refined bars, 1.7 cts. for iron and steel; steel plates, 1.85 to 2 cts. for tank, 2 to 2.15 cts. for shell, 2.05 to 2.2 cts. for flange, 3.6 to 3.75 cts. for firebox. Chicago; beams, 2.25 to 2.3 cts.; channels, 2.25 to 2.3 cts.; angles, 2 to 2.25 cts.; tees, 2.25 to 2.4 cts.; universal plates, 2.15 to 2.25 cts.; steel plates, 2.1 to 2.4 cts. for tank and 2.5 to 2.75 cts. for flange.